THE ENVIRONMENTAL EFFECTS ON TBG-B PLATFORM

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CERTIFICATION OF APPROVAL

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Dissertation submitted to the
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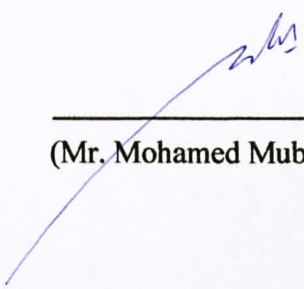
Approved by,



(Mr. Mohamed Mubarak bin Abdul Wahab)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

July 2009

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

NUR FAIZAH BTE P. MOSAR

ABSTRACT

This study presents an approach to obtain the pattern of wind, wave, and current loads acting on the TBG-B platform when the environmental loads subjected to offshore platforms might change in intensity after several years of installation. Wave height, wave period, current velocity and wind velocity are among the environmental parameters that might change with time. In this project, those parameters were manipulated separately and analyzed using SACS software.

The main objective of this project is to assess the behavior of TBG-B platform due to the increment in the environmental forces. The increment of the environmental forces is obtained by manipulating the environmental parameters as mentioned above. The output generated by SACS software is tabulated and analyzed in order to obtain the relationship.

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CHAPTER 1
INTRODUCTION

1.1 Project Background

An offshore platform is a large structure used to house workers and machinery needed to drill in the ocean bed, extract oil and natural gas, process the produced fluids, and ship them to shore. Since 1947, about 10,000 offshore structures constructed worldwide. 95 percent of offshore platform around the world today are fixed type platform as shown in the Figure 1.1a below.

Figure 1.1a: Fixed Platform [1]

Fixed offshore platforms consist of interconnected steel tubular members to support the structure. Usually these types of platforms have three to eight legs welded together with pipe braces to form a stool like structure. The piles which are also tubular will be driven into the seabed up to several hundreds of feet beneath the mudline. These platforms can support a super structure that having two or three decks which consists of drilling and production equipments. However, these platforms are limited to 500 to 600 feet water

depth below mean sea level. For this project, TBG-B platform which is a fixed type platform that situated in South China Sea will be used for analysis. TBG-B platform is further described in detail in section 1.2 below.

1.2 TBG-B Platform Overview

TBG-B is a four (4)-pile wellhead platform installed in 1993 and located in Tembungo Field in South China Sea. The jacket legs are 60" Ø (152.4) and the piles are 54" Ø (137.2 cm) and grouted. The platform supports one (1) number of 6.625" Ø (16.8 cm) existing riser and one (1) number of 6.625" Ø (16.8 cm) future riser, nine (9) numbers of 26" Ø (66.0 cm) conductors (three (3) conductors are added at the later stage complete with additional conductor support), two 26" Ø (66.0 m) sump pipes, one boatlanding on the Platform East face, a conductor guard and a riser guard. The topside comprises of the Wireline Deck and a Scrapper Deck [2].

Details of the structure and its configuration are summarized as below:

Structure Identification	:	TBG-B
Structure Function	:	Cluster Drilling Platform
Installation Date	:	September, 1993
Water Depth (MSL)	:	85.65 m (281.00 ft)
No. of Piles	:	4
Pile Penetration Below Mudline	:	48.0 m (157.48 ft)
Number of Riser	:	2 (16.8 cm Ø) (one for future)
Number of Conductor	:	9 (66.0 cm Ø)
Number of Anode	:	80

A 3-dimensional view of the TBG-B platform is shown in Figure 1.2a and Figure 1.2b.

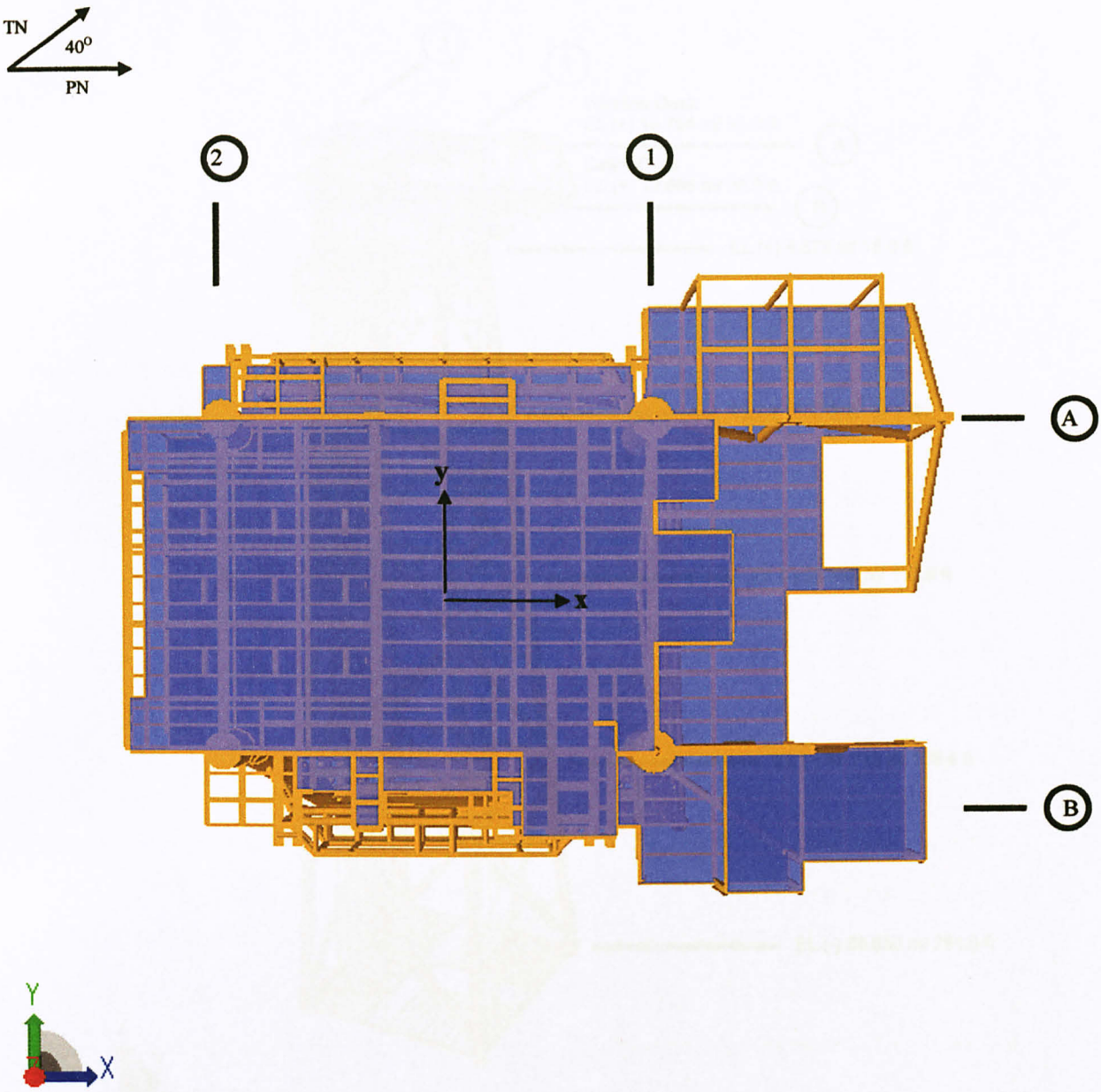


Figure 1.2a: TBG-B Plan View & Orientation

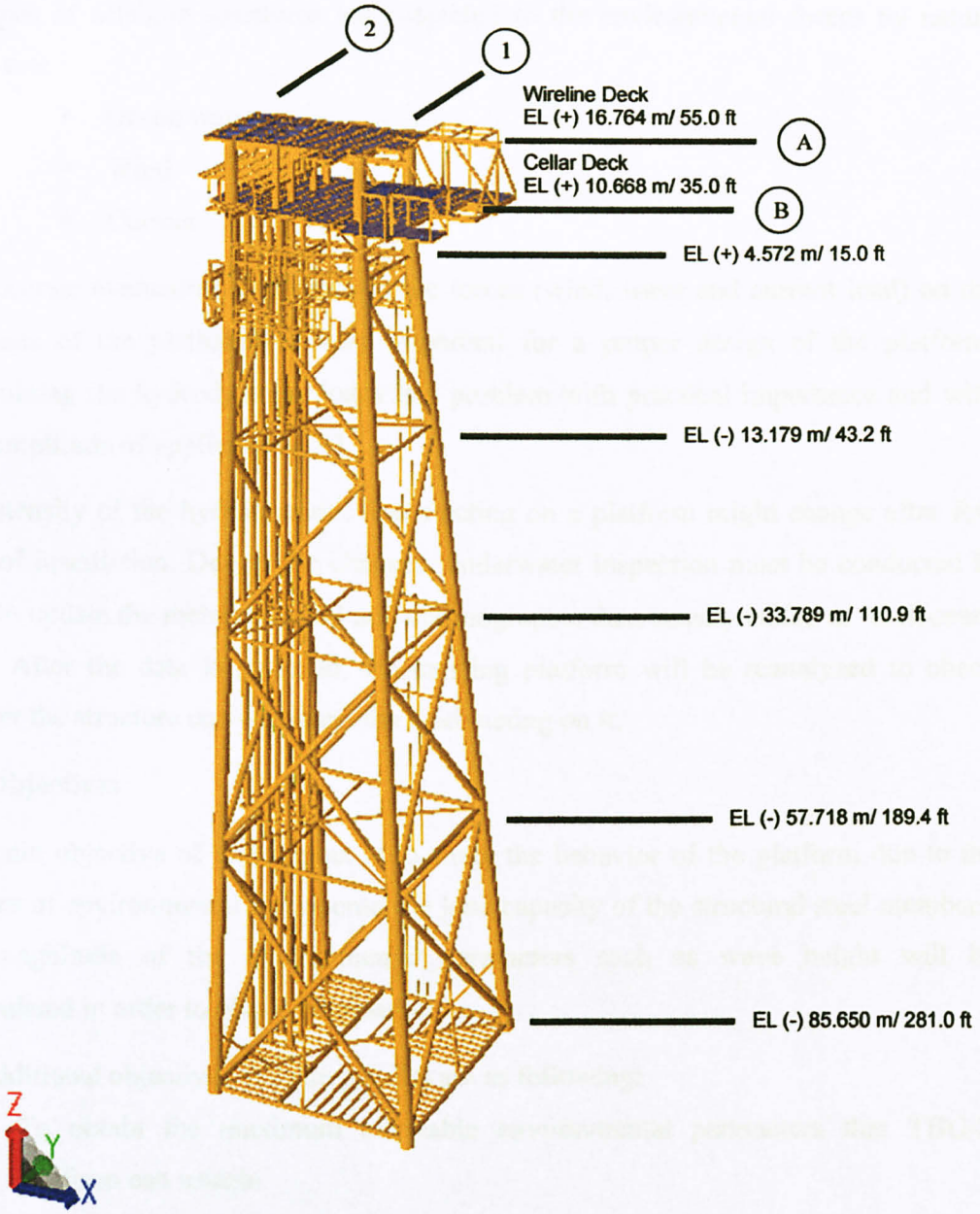


Figure 1.2b: TBG-B Platform 3-Dimensional View

1.3 Problem Statement

All types of offshore structures are subjected to the environmental forces by nature which are:

- Ocean waves
- Wind
- Current

The accurate evaluation of hydrodynamic forces (wind, wave and current load) on the structures of the platforms is very important for a proper design of the platform. Determining the hydrodynamic loads is a problem with practical importance and with large amplitude of applications [3].

The intensity of the hydrodynamic loads acting on a platform might change after few years of installation. Due to the changes, underwater inspection must be conducted in order to update the meteorological and oceanographic data usually called as 'metocean' data. After the data is gathered, the existing platform will be reanalyzed to check whether the structure can withstand the loads acting on it.

1.4 Objectives

The main objective of this project is to study the behavior of the platform due to the changes of environmental forces onto the load capacity of the structural steel members. The magnitude of the environmental parameters such as wave height will be manipulated in order to obtain the results.

The additional objectives that run parallel are as following:

- To obtain the maximum allowable environmental parameters that TBG-B platform can sustain.
- To obtain the average increment of environmental forces when different environmental parameters is being manipulated.

CHAPTER 2
LITERATURE REVIEW

2.1 Waves

Generally, waves are random in nature. Ocean surface waves are surface waves that occur on the free surface of the ocean. They usually result from wind, and are also referred to as wind waves. There is little actual forward motion of individual water particles in a wave, despite the large amount of energy it may carry forward. Tsunamis are a specific type of wave not caused by wind but by geological effects. In deep water, tsunamis are not visible because they are small in height and very long in wavelength. They may grow to devastating proportions at the coast due to reduced water depth.

Concerning the action of waves, there are two major wave-induced forces exerted on structures. The drag force F_D is due to frictional and form drag; its magnitude depends on shape, roughness of the object, Reynolds number of the flow, and intensity of turbulance in the flow. The inertia force F_I is due to water-particle acceleration. It is assumed in practical application that the total wave forces acting on a structure can be obtained by linearly superimposing the drag and inertia forces [3]. This is the basis of Morison equation, as [4]:

$$F = 0.5\,\rho\, C_d\, D\, |u|\, u + 0.25\,\rho\,\pi\, D^2\, C_m\, a$$

where F = Force per unit length of member
ρ = density of seawater
C_d = drag coefficient
C_m = inertia coefficient
D = hydrodynamic diameter
u = water particle velocity
a = water particle acceleration

For the generation of wave forces, the C_d and C_m values are based on API RP2A, 21st Edition is used in the analysis.

The following Table 2.1a tabulates the C_d & C_m for tubular members [5]:

Table 2.1a: Cd and Cm values for smooth and rough surface

Smooth		Rough	
C_d	C_m	C_d	C_m
0.65	1.60	1.05	1.20

There are several wave theories applied to the offshore structures design which are:

- Linear Wave Theory
- Second-Order Stokes Wave Theory
- Fifth-Order Stokes Wave Theory
- Stream Function Theory

There are three parameters needed in describing any wave theory, which are [6]:

- Period (T) – Time taken for two successive crests to pass a stationary point.
- Height (H) – Vertical distance between the crest and the following trough.
- Water depth (d) – Vertical distance from the mean water level to the mean ocean floor.

In order to select wave theory in the calculation of response of offshore structure, second-order theory or higher is required for high wave heights which results from large storms.

2.1.1 Linear Wave Theory

Linear wave theory is the simplest and most applied wave theory. it is also called as small amplitude wave theory or Airy theory. The wave has the form of a sin curve and the free surface profile is written as following:

$\eta = a \sin(kx - \omega t)$

Where,

- a is the wave amplitude in meter,
- k is the angular wave number in radian per meter, related to the wavelength λ

$$k = \frac{2\pi}{\lambda},$$

- ω is the angular frequency in radian per second, related to the period T and frequency f by

$$\omega = \frac{2\pi}{T} = 2\pi f.$$

Wave height H is the difference in elevation between crest and trough as in the equation below:

$$H = 2a$$

Underneath the surface, the fluid motion is associated with the free surface motion. While the surface elevation shows a propagating wave, the fluid particles are in an orbital motion. Within the framework of Airy wave theory, the orbits are in deep water closed circles, and in finite depth closed ellipsoids becoming flatter near the bottom of the fluid layer. So while the wave propagates, the fluid particles just orbit around their average position. With the propagating wave motion, the fluid particles transfer energy in the wave propagation direction, without having a mean velocity. The diameter of the orbits reduces with depth below the free surface. In deep water, the orbit's diameter is reduces to 4% of its free-surface value at a depth of half a wavelength [6].

2.1.2 Second-Order Stokes Wave Theory

Stokes second-order wave provide two component for the wave kinematics, the first one at the wave frequency and the second one at the twice the wave frequency. The second-order component is smaller than the first-order contribution. The wave profiles from the two components combine to provide a steeper crest and shallower trough. The second-order contribution is smaller in deep water [7].

2.1.3 Fifth-Order Stokes Wave Theory

Fifth-order stokes wave theory is applicable for deep-water high waves. This theory comprises five components in a series form. The higher components decay faster with depth and their effects in deeper depth are negligible. Therefore, even though this theory is used in the design of offshore structure, it has significant effect only near the free surface. The waves behave like linear wave when it is in deeper depth. Due to this effect, the structural components in deep-water steep waves can be design with linear theory without any measurable error. Fifth-order stokes wave theory will have significant effect on structural responses as impact on the superstructure, airgap beneath the deck as well as the motion of a shallow draft floating structure[7].

2.1.4 Stream Function Theory

Stream function wave theory was developed to examine fully nonlinear water waves numerically. The method involves computing a series solution to the fully nonlinear water wave problem, involving the Laplace equation with two nonlinear free surface boundary conditions (constant pressure and wave height constraint)[7].

The order of the Stream function wave is a measure of how nonlinear the wave is. Because the order of stream function is open, it covers very small waves to very steep waves. In deep water, the order can be as low as 3 to 5, while in very shallow water, the order can be as great as 30 [8].

2.2 Applicability of Wave Theory

Region of validity of the various theories discussed earlier are applicable to offshore structures in relatively deeper waters is as shown in figure 2a [9].

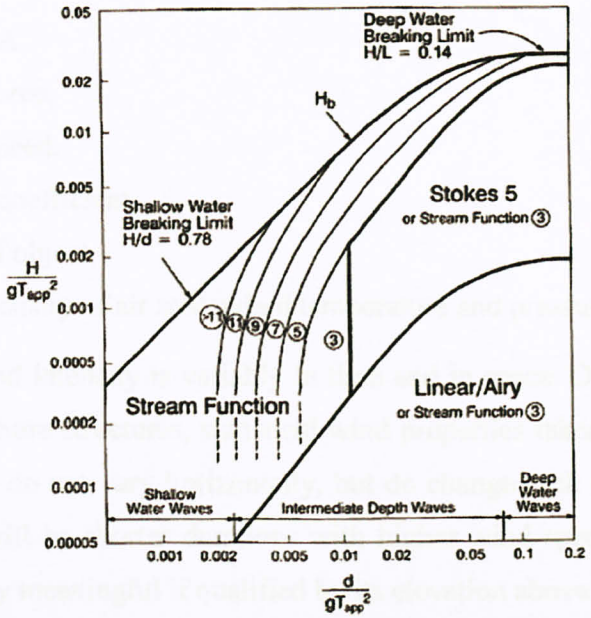


Figure 2.2a Region of Application of Wave Theories [9]

Since the basic wave parameters are *H, T* and *d,* the region are shown as functions of:

- $H/(gT^2)$ – Dimensionless wave steepness
- $d/(gT^2)$ – Dimensionless relative depth

2.3 Wind

Wind forces are acting on the portion of structure that is above the Mean Sea Level (MSL) as well as any equipment, deck that located on the platform. Wind velocities for both 100-year storm and operating condition are required for analyzing the structure. Wind speed and direction vary in space and time. Wind properties such as mean and standard deviation of velocity do not vary horizontally but changes with the elevation. The wind speed value is only meaningful if qualified by its elevation and duration. The wind speed is used to obtain wind force acting on offshore structure using following formula [9]:

$F = (\rho / 2) (V)^2 C_s A$

where: F = wind force,

V= wind speed,

C_s= shape coefficient,

A = area of object,

ρ = mass density of air at standard temperature and pressure (1.226 kg/m^3)

Generally, the wind intensity is variably in time and in space. On length scales typical of even large offshore structures, statistical wind properties taken over durations of the order of one hour do not vary horizontally, but do change with elevation. Within long durations, there will be shorter durations with higher wind speeds. Therefore, a wind speed value is only meaningful if qualified by its elevation above sea level and duration. The wind loads on the structure of offshore platform are dynamic in nature. In the case of the fixed offshore platforms, wind loads are representing 10 percent of the whole environmental loads, but its importance is not negligible for the static and dynamic analysis of these platforms [3].

CHAPTER 3
METHODOLOGY

This project is required to complete in two semesters. In this chapter, detail plan on overall project progress plan for both semesters will be discussed in order to meet the requirements.

3.1 Early Information

Since semester started, plenty of readings have been done in order to gather as much information as possible as listed below. This step is the most important one in order to gain deep understanding in the current issues and challenges faced related to this project. Among the sources of information are as follows;

- Handbook – Books related to offshore engineering and related issues.
- Journals – Journals from Information Resource Centre (IRC), Universiti Teknologi PETRONAS
- Website – Online journals.
- Expertise – Discussed current issues and problem on offshore structure with *Mrs Sapiah Sheikh Hussin*, Senior Structural Engineer from RNZ Integrated (M) Sdn Bhd, Oil and Gas Consulting firm.
  – Attended special class regarding wave action on offshore structures, by *Assoc. Prof. Dr. Kurian V. John*, Lecturer at Universiti Teknologi Petronas (UTP).

3.2 Project Activity

After years of platform installation, environmental forces such as wave height might change by nature itself. Besides wave height, as a platform becomes older, the behavior of the steel members itself might change due to corrosion, marine growth as well as scouring. Thus changes will weaken the steel members which will affect the load

bearing capacity that the platform can support. For this project, the environmental parameters as shown in Figure 3.2a below will be manipulated in the analysis.

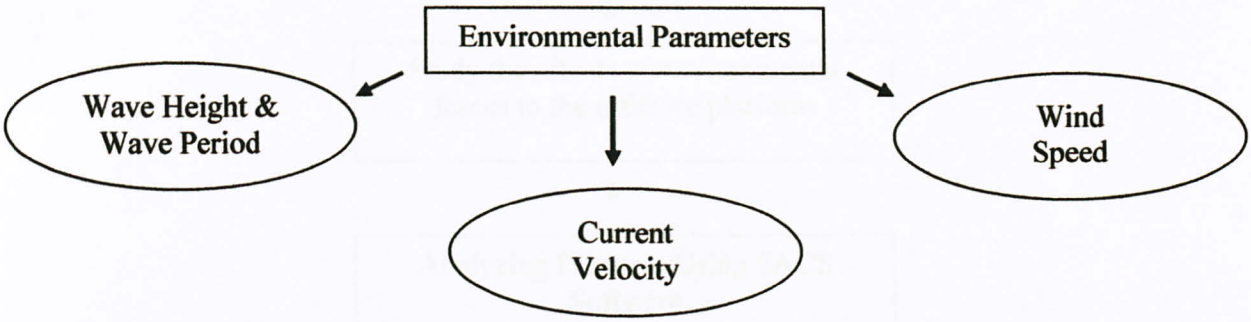


Figure 3.2a: Environmental forces acting on offshore platform

The hydrodynamic forces (wind, wave and current) have been manipulated in the analysis. The range of environmental parameters is constructed by comparing environmental parameters in Domestic Zones in Malaysian Waters (Peninsular Malaysia Operation, Erb West) which is taken from PETRONAS Technical Specification (PTS) [10]. The changes are considered in the SACS analysis to obtain the worst case that might occur due to the environmental effects. In order to obtain the relationship between the changes of environmental forces with the performance of steel members of TBG-B platform, SACS data input (wave height, wave period, wind speed, current velocity) is manipulated. From the manipulation, the performance of the structure is obtained. In addition, the input data is manipulated in all conditions which consist of operating and storm. Figure 3.2b shows the overall flow for the project. Detailed milestone for the project flow is available in Appendix A and Appendix B.

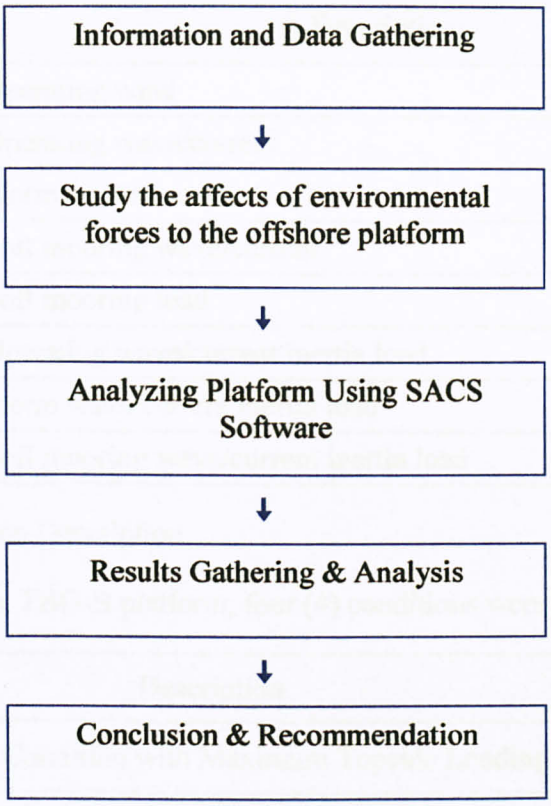


Figure 3.2b: Project flow planning for both semesters

3.2.1 Basic Load Cases Description

Table 3.2a below describes the basic load cases. The environmental loads used in the analysis will be described further in Section 3.2.2 to Section 3.2.5.

Table 3.2a: Basic Load Case

Load case	Description
1	Computer generated submerged weight
2A	Jacket appurtenance weight
2B	Deck appurtenance weight
3	Equipment operating weight
4	Piping operating weight
5	Jib crane dead load
6A	Jacket Walkway live load
6B	Topside open area live load

Load case	Description
7,8	Operating wind
101-108	Operating wave/current
111-118	Storm wave/current
311-313	Soft mooring wave/current
301-303	Soft mooring load
121-128	Operating wave/current inertia load
131-138	Storm wave/current inertia load
321-323	Soft mooring wave/current inertia load

3.2.2 Load Combination Description

In the SACS analysis for TBG-B platform, four (4) conditions were analyzed, namely:

Condition	Description	Load combination
I	Operating Condition with Maximum Topside Loading	OP01 – OP08
II	Storm Condition with Maximum Topside Loading	ST01 – ST08
III	Storm Condition with Minimum Topside Loading	SX01 – SX08
IV	Operating Condition with Soft Mooring Load	SM11 – SM63

Table 3.2b to 3.2e presents the load combinations for 100-year storm and 1-year operating conditions for original model.

Table 3.2b: Operating Wave/Current with Maximum Topside Condition

Basic LC	Condition	Condition I – Operating							
	Direction (deg)	0	41.37	90	138.63	180	221.37	270	318.63
	Description	OP01	OP02	OP03	OP04	OP05	OP06	OP07	OP08
1	Computer generated selfweight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
2A	Jacket appurtenances dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
2B	Topside appurtenances dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
3	Equipment operating weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
4	Piping operating weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
5	Jib crane dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
6A	Jacket walkway live load 5kPa	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6B	Topside open area live load 5kPa	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	Operating wind in (+) x-dir	1.000	0.500		-0.500	-1.000	-0.500		0.500
8	Operating wind in (+) y-dir		0.500	1.000	0.500		-0.500	-1.000	-0.500

Basic LC	Condition	Condition I – Operating							
	Direction (deg)	0	41.37	90	138.63	180	221.37	270	318.63
	Description	OP01	OP02	OP03	OP04	OP05	OP06	OP07	OP08
101	Operating wave/current @ 0 deg	1.050							
102	Operating wave/current @ 41.37 deg		1.050						
103	Operating wave/current @ 90 deg			1.050					
104	Operating wave/current @ 138.63 deg				1.050				
105	Operating wave/current @ 180 deg					1.050			
106	Operating wave/current @ 221.37 deg						1.050		
107	Operating wave/current @ 270 deg							1.050	
108	Operating wave/current @ 318.63 deg								1.050
111	Storm wave/current @ 0 deg								
112	Storm wave/current @ 41.37 deg								
113	Storm wave/current @ 90 deg								
114	Storm wave/current @ 138.63 deg								
115	Storm wave/current @ 180 deg								
116	Storm wave/current @ 221.37 deg								
117	Storm wave/current @ 270 deg								
118	Storm wave/current @ 318.63 deg								
121	Operating wave/current inertial load @ 0 deg	0.086							
122	Operating wave/current inertial load @ 41.37 deg		0.086						
123	Operating wave/current inertial load @ 90 deg			0.086					
124	Operating wave/current inertial load @ 138.63 deg				0.086				
125	Operating wave/current inertial load @ 180 deg					0.086			
126	Operating wave/current inertial load @ 221.37 deg						0.086		
127	Operating wave/current inertial load @ 270 deg							0.086	
128	Operating wave/current inertial load @ 318.63 deg								0.086
131	Storm wave/current inertial load @ 0 deg								
132	Storm wave/current inertial load @ 41.37 deg								
133	Storm wave/current inertial load @ 90 deg								
134	Storm wave/current inertial load @ 138.63 deg								
135	Storm wave/current inertial load @ 180 deg								
136	Storm wave/current inertial load @ 221.37 deg								
137	Storm wave/current inertial load @ 270 deg								
138	Storm wave/current inertial load @ 318.63 deg								
301	Soft mooring loads @ 0 deg								
302	Soft mooring loads @ 318.63 deg								
303	Soft mooring loads @ 270 deg								
311	Soft mooring wave/current load @ 0 deg								
312	Soft mooring wave/current load @ 318.63 deg								
313	Soft mooring wave/current load @ 270 deg								
321	Soft mooring wave/current inertial load @ 0 deg								
322	Soft mooring wave/current inertial load @ 318.63°								
323	Soft mooring wave/current inertial load @ 270 deg								

Table 3.2c: Storm Wave/Current with Maximum Topside Condition

Basic LC	Condition	Condition II - Storm + Maximum Topside							
	Direction (deg)	0	41.37	90	138.63	180	221.37	270	318.63
	Description	ST01	ST02	ST03	ST04	ST05	ST06	ST07	ST08
1	Computer generated self weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
2A	Jacket appurtenances dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
2B	Topside appurtenances dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
3	Equipment operating weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
4	Piping operating weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
5	Jib crane dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
6A	Jacket walkway live load 5kPa	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6B	Topside open area live load 5kPa	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	Operating wind in (+) x-dir	4.000	2.000		-2.000	-4.000	-2.000		2.000
8	Operating wind in (+) y-dir		2.000	4.000	2.000		-2.000	-4.000	-2.000
101	Operating wave/current @ 0 deg								
102	Operating wave/current @ 41.37 deg								
103	Operating wave/current @ 90 deg								
104	Operating wave/current @ 138.63 deg								
105	Operating wave/current @ 180 deg								
106	Operating wave/current @ 221.37 deg								
107	Operating wave/current @ 270 deg								
108	Operating wave/current @ 318.63 deg								
111	Storm wave/current @ 0 deg	1.050							
112	Storm wave/current @ 41.37 deg		1.050						
113	Storm wave/current @ 90 deg			1.050					
114	Storm wave/current @ 138.63 deg				1.050				
115	Storm wave/current @ 180 deg					1.050			
116	Storm wave/current @ 221.37 deg						1.050		
117	Storm wave/current @ 270 deg							1.050	
118	Storm wave/current @ 318.63 deg								1.050
121	Operating wave/current inertial load @ 0 deg								
122	Operating wave/current inertial load @ 41.37 deg								
123	Operating wave/current inertial load @ 90 deg								
124	Operating wave/current inertial load @ 138.63 deg								
125	Operating wave/current inertial load @ 180 deg								
126	Operating wave/current inertial load @ 221.37 deg								
127	Operating wave/current inertial load @ 270 deg								
128	Operating wave/current inertial load @ 318.63 deg								
131	Storm wave/current inertial load @ 0 deg	0.062							
132	Storm wave/current inertial load @ 41.37 deg		0.115						
133	Storm wave/current inertial load @ 90 deg			0.115					
134	Storm wave/current inertial load @ 138.63 deg				0.115				
135	Storm wave/current inertial load @ 180 deg					0.062			
136	Storm wave/current inertial load @ 221.37 deg						0.055		
137	Storm wave/current inertial load @ 270 deg							0.055	
138	Storm wave/current inertial load @ 318.63 deg								0.055
301	Soft mooring loads @ 0 deg								
302	Soft mooring loads @ 318.63 deg								

Basic LC	Condition	Condition II - Storm + Maximum Topside							
	Direction (deg)	0	41.37	90	138.63	180	221.37	270	318.63
	Description	ST01	ST02	ST03	ST04	ST05	ST06	ST07	ST08
303	Soft mooring loads @ 270 deg								
311	Soft mooring wave/current load @ 0 deg								
312	Soft mooring wave/current load @ 318.63 deg								
313	Soft mooring wave/current load @ 270 deg								
321	Soft mooring wave/current inertial load @ 0 deg								
322	Soft mooring wave/current inertial load @ 318.63°								
323	Soft mooring wave/current inertial load @ 270 deg								

Table 3.2d: Storm Wave/Current with Minimum Topside Condition

Basic LC	Condition	Condition III - Storm + Minimum Topside							
	Direction (deg)	0	41.37	90	138.63	180	221.37	270	318.63
	Description	SX01	SX02	SX03	SX04	SX05	SX06	SX07	SX08
1	Computer generated selfweight	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2A	Jacket appurtenances dead load	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2B	Topside appurtenances dead load	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3	Equipment operating weight	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4	Piping operating weight	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5	Jib crane dead load	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6A	Jacket walkway live load 5kPa								
6B	Topside open area live load 5kPa								
7	Operating wind in (+) x-dir	4.000	2.000		-2.000	-4.000	-2.000		2.000
8	Operating wind in (+) y-dir		2.000	4.000	2.000		-2.000	-4.000	-2.000
101	Operating wave/current @ 0 deg								
102	Operating wave/current @ 41.37 deg								
103	Operating wave/current @ 90 deg								
104	Operating wave/current @ 138.63 deg								
105	Operating wave/current @ 180 deg								
106	Operating wave/current @ 221.37 deg								
107	Operating wave/current @ 270 deg								
108	Operating wave/current @ 318.63 deg								
111	Storm wave/current @ 0 deg	1.050							
112	Storm wave/current @ 41.37 deg		1.050						
113	Storm wave/current @ 90 deg			1.050					
114	Storm wave/current @ 138.63 deg				1.050				
115	Storm wave/current @ 180 deg					1.050			
116	Storm wave/current @ 221.37 deg						1.050		
117	Storm wave/current @ 270 deg							1.050	
118	Storm wave/current @ 318.63 deg								1.050
121	Operating wave/current inertial load @ 0 deg								
122	Operating wave/current inertial load @ 41.37 deg								
123	Operating wave/current inertial load @ 90 deg								
124	Operating wave/current inertial load @ 138.63 deg								
125	Operating wave/current inertial load @ 180 deg								
126	Operating wave/current inertial load @ 221.37 deg								
127	Operating wave/current inertial load @ 270 deg								

Basic LC	Condition	Condition III - Storm + Minimum Topside							
	Direction (deg)	0	41.37	90	138.63	180	221.37	270	318.63
	Description	SX01	SX02	SX03	SX04	SX05	SX06	SX07	SX08
128	Operating wave/current inertial load @ 318.63 deg								
131	Storm wave/current inertial load @ 0 deg	0.062							
132	Storm wave/current inertial load @ 41.37 deg		0.115						
133	Storm wave/current inertial load @ 90 deg			0.115					
134	Storm wave/current inertial load @ 138.63 deg				0.115				
135	Storm wave/current inertial load @ 180 deg					0.062			
136	Storm wave/current inertial load @ 221.37 deg						0.055		
137	Storm wave/current inertial load @ 270 deg							0.055	
138	Storm wave/current inertial load @ 318.63 deg								0.055
301	Soft mooring loads @ 0 deg								
302	Soft mooring loads @ 318.63 deg								
303	Soft mooring loads @ 270 deg								
311	Soft mooring wave/current load @ 0 deg								
312	Soft mooring wave/current load @ 318.63 deg								
313	Soft mooring wave/current load @ 270 deg								
321	Soft mooring wave/current inertial load @ 0 deg								
322	Soft mooring wave/current inertial load @ 318.63 °								
323	Soft mooring wave/current inertial load @ 270 deg								

Table 3.2e: Soft Mooring Condition

asic LC	Condition	Condition 6 - Soft Mooring			Condition 6 - Soft Mooring			Condition 6 - Soft Mooring		
	Direction (deg)	0	318.63	270	0	318.63	270	0	318.63	270
	Description	SM11	SM12	SM13	SM21	SM22	SM23	SM31	SM32	SM33
1	Computer generated self weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
2A	Jacket appurtenances dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
2B	Topside appurtenances dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
3	Equipment operating weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
4	Piping operating weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
5	Jib crane dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
6A	Jacket walkway live load 5kPa	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6B	Topside open area live load 5kPa	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	Operating wind in (+) x-dir	1.000	0.500		1.000	0.500		1.000	0.500	
8	Operating wind in (+) y-dir		-0.500	-1.000		-0.500	-1.000		-0.500	-1.000
101	Operating wave/current @ 0 deg									
102	Operating wave/current @ 41.37 deg									
103	Operating wave/current @ 90 deg									
104	Operating wave/current @ 138.63 deg									
105	Operating wave/current @ 180 deg									
106	Operating wave/current @ 221.37 deg									
107	Operating wave/current @ 270 deg									
108	Operating wave/current @ 318.63 deg									
111	Storm wave/current @ 0 deg									
112	Storm wave/current @ 41.37 deg									
113	Storm wave/current @ 90 deg									

asic LC	Condition	Condition 6 - Soft Mooring			Condition 6 - Soft Mooring			Condition 6 - Soft Mooring		
	Direction (deg)	0	318.63	270	0	318.63	270	0	318.63	270
	Description	SM11	SM12	SM13	SM21	SM22	SM23	SM31	SM32	SM33
114	Storm wave/current @ 138.63 deg									
115	Storm wave/current @ 180 deg									
116	Storm wave/current @ 221.37 deg									
117	Storm wave/current @ 270 deg									
118	Storm wave/current @ 318.63 deg									
121	Operating wave/current inertial load @ 0 deg									
122	Operating wave/current inertial load @ 41.37 deg									
123	Operating wave/current inertial load @ 90 deg									
124	Operating wave/current inertial load @ 138.63 °									
125	Operating wave/current inertial load @ 180 deg									
126	Operating wave/current inertial load @ 221.37 °									
127	Operating wave/current inertial load @ 270°									
128	Operating wave/current inertial load @ 318.63 °									
131	Storm wave/current inertial load @ 0 deg									
132	Storm wave/current inertial load @ 41.37 deg									
133	Storm wave/current inertial load @ 90 deg									
134	Storm wave/current inertial load @ 138.63 deg									
135	Storm wave/current inertial load @ 180 deg									
136	Storm wave/current inertial load @ 221.37 deg									
137	Storm wave/current inertial load @ 270 deg									
138	Storm wave/current inertial load @ 318.63 deg									
301	Soft mooring loads @ 0 deg	1.000			2.000			3.000		
302	Soft mooring loads @ 318.63 deg		1.000			2.000			3.000	
303	Soft mooring loads @ 270 deg			1.000			2.000			3.000
311	Soft mooring wave/current load @ 0 deg	1.050			1.050			1.050		
312	Soft mooring wave/current load @ 318.63 deg		1.050			1.050			1.050	
313	Soft mooring wave/current load @ 270 deg			1.050			1.050			1.050
321	Soft mooring wave/current inertial load @ 0 deg	0.044			0.044			0.044		
322	Soft mooring wave/current inertial load @ 318.63°		0.044			0.044			0.044	
323	Soft mooring wave/current inertial load @ 270 °			0.044			0.044			0.044

Table 3.2e: Soft Mooring Condition (cont'd)

Basic LC	Condition	Condition 6 - Soft Mooring			Condition 6 - Soft Mooring			Condition 6 - Soft Mooring		
	Direction (deg)	0	318.63	270	0	318.63	270	0	318.63	270
	Description	SM41	SM42	SM43	SM51	SM52	SM53	SM61	SM62	SM63
1	Computer generated self weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
2A	Jacket appurtenances dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
2B	Topside appurtenances dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
3	Equipment operating weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
4	Piping operating weight	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
5	Jib crane dead load	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
6A	Jacket walkway live load 5kPa	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6B	Topside open area live load 5kPa	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	Operating wind in (+) x-dir	1.000	0.500		1.000	0.500		1.000	0.500	

Basic LC	Condition	Condition 6 - Soft Mooring			Condition 6 - Soft Mooring			Condition 6 - Soft Mooring		
	Direction (deg)	0	318.63	270	0	318.63	270	0	318.63	270
	Description	SM41	SM42	SM43	SM51	SM52	SM53	SM61	SM62	SM63
8	Operating wind in (+) y-dir		-0.500	-1.00		-0.500	-1.000		-0.500	-1.00
101	Operating wave/current @ 0 deg									
102	Operating wave/current @ 41.37 deg									
103	Operating wave/current @ 90 deg									
104	Operating wave/current @ 138.63 deg									
105	Operating wave/current @ 180 deg									
106	Operating wave/current @ 221.37 deg									
107	Operating wave/current @ 270 deg									
108	Operating wave/current @ 318.63 deg									
111	Storm wave/current @ 0 deg									
112	Storm wave/current @ 41.37 deg									
113	Storm wave/current @ 90 deg									
114	Storm wave/current @ 138.63 deg									
115	Storm wave/current @ 180 deg									
116	Storm wave/current @ 221.37 deg									
117	Storm wave/current @ 270 deg									
118	Storm wave/current @ 318.63 deg									
121	Operating wave/current inertial load @ 0 deg									
122	Operating wave/current inertial load @ 41.37 deg									
123	Operating wave/current inertial load @ 90 deg									
124	Operating wave/current inertial load @ 138.63°									
125	Operating wave/current inertial load @ 180 deg									
126	Operating wave/current inertial load @ 221.37 °									
127	Operating wave/current inertial load @ 270 deg									
128	Operating wave/current inertial load @ 318.63°									
131	Storm wave/current inertial load @ 0 deg									
132	Storm wave/current inertial load @ 41.37 deg									
133	Storm wave/current inertial load @ 90 deg									
134	Storm wave/current inertial load @ 138.63 deg									
135	Storm wave/current inertial load @ 180 deg									
136	Storm wave/current inertial load @ 221.37 deg									
137	Storm wave/current inertial load @ 270 deg									
138	Storm wave/current inertial load @ 318.63 deg									
301	Soft mooring loads @ 0 deg	4.000			5.000			6.000		
302	Soft mooring loads @ 318.63 deg		4.000			5.000			6.000	
303	Soft mooring loads @ 270 deg			4.000			5.000			6.000
311	Soft mooring wave/current load @ 0 deg	1.050			1.050			1.050		
312	Soft mooring wave/current load @ 318.63 deg		1.050			1.050			1.050	
313	Soft mooring wave/current load @ 270 deg			1.050			1.050			1.050
321	Soft mooring wave/current inertial load @ 0 deg	0.044			0.044			0.044		
322	Soft mooring wave/current inertial load @ 318.63°		0.044			0.044			0.044	
323	Soft mooring wave/current inertial load @ 270°			0.044			0.044			0.044

3.2.3 Environmental Loads

The environmental data used in this analysis is based on "Structural Integrity Assessment Basis" [5] Metocean data and PETRONAS Technical Specification (PTS) [10]. For generating wave / current forces, the following parameters were used in the analysis:

a) Applicable wave theory shall be determined based on water depth. In this case, Stokes Function wave theory is used for the wave load generation base on API RP2A Working Stress Design (WSD) [9].

b) Wave spreading factor of 0.90 is used for storm condition.

c) Current blockage factor of 0.80 for end-on, 0.85 for broadside, and 0.80 for diagonal are used for storm and operating conditions.

d) For in-place model, eight (8) directional waves and currents are used for storm condition and eight (8) omni-directional waves and currents are used for operating condition. Meanwhile for PMO and Erb West model, eight (8) omni-directional waves and currents are used for both storm and operating condition.

e) All wave and current loads are factored by 1.05 in the combined load case to account for the increase in wave loading due to the unmodelled appurtenances such as anodes.

3.2.4 Wind Load

The wind forces are calculated based on 1-year return period for 1-minute mean. The wind forces were factored in the load combinations to derive the 100-year wind forces. Comparison has been made for environmental parameters of wind velocity that taken from PETRONAS Technical Specification (PTS) [10] for Peninsular Malaysia Operation (PMO) with TBG-B in-place analysis that has been done in 2008 using metocean data [11] by PCSB. Detailed calculation of wind force has been attached in Appendix C.1. Table 3.2e below shows the range of wind speed which were used in the analysis in order to observe how the increment of wind speed will affect TBG-B platform.

Table 3.2f: Wind Speed Parameters for Analysis.

Condition	Unit	Analysis 1	Analysis 2	Analysis 3	Analysis 4
Operating	m/s	16	18	20	22
Storm	m/s	36	40	44	48

As shown in Table 3.2f, the wind speeds are evenly divided. The increment in wind speed will cause higher wind forces subjected to the platform which will cause the members and joints affected to sustain higher load.

Load Combination

As the wind speed for both operating and storm condition is different compared to the in-place analysis, the value of the wind load combination factor for 'storm + minimum topside loading (storm min)' condition and 'storm + maximum topside loading (storm max)' condition will be different as the variable is wind. Wind load combination factor has been calculated as:

Load Combination Factor $= (Vstorm)^2 / (Voperating)^2$

The calculated wind load factor is included in the SACS input file before executing the SACS analysis.

3.2.5 Wave Load

The original wave loads used in the analysis were derived from 100-year and 1-year return period of Metocean criteria [11]. Summary of the maximum wave height and its associated wave period used in the analysis is tabulated in Table 3.2g.

Table 3.2g: Range of Wave Parameters for Analysis

Wave	Condition	Analysis 1	Analysis 2	Analysis 3	Analysis 4
Hmax (m)	Operating	6	6.5	7	7.5
	Storm	11	11.5	12	12.5
Tass (sec)	Operating	7	7.5	8	8.5
	Storm	9.5	10	10.5	11

The original model of TBG-B platform is considering omni-directional wave for operating condition and directional wave for storm condition in eight (8) directions with the corresponding maximum wave height (H_{max}) and associate wave period (T_{ass}). The wave and current attack angle is available in Appendix D for further reference.

3.2.6 Current Load

The current velocity used in original model is tabulated in Table 3.2h. The omni-directional and directional 1-year and 100-year wave and current respectively, used in the in-place analysis are presented in Figure 3.2c and 3.2d.

Table 3.2h: Parameters of current for in-place analysis

Current	Depth	Field								
		In-Place								
		Operating	Storm							
			N	NE	E	SE	S	SW	W	NW
At Surface	D	1.55	0.91	2.23	1.09	0.62	0.71	1.05	0.96	0.69
	0.75 D	1.41	0.83	2.03	0.99	0.56	0.65	0.95	0.87	0.63
At Mid Depth	0.50 D	1.23	0.72	1.77	0.87	0.49	0.56	0.83	0.76	0.55
	0.25 D	0.98	0.57	1.41	0.69	0.39	0.45	0.66	0.61	0.43
At Near Sea Bed	0.05 D	0.57	0.34	0.82	0.40	0.23	0.26	0.39	0.35	0.25

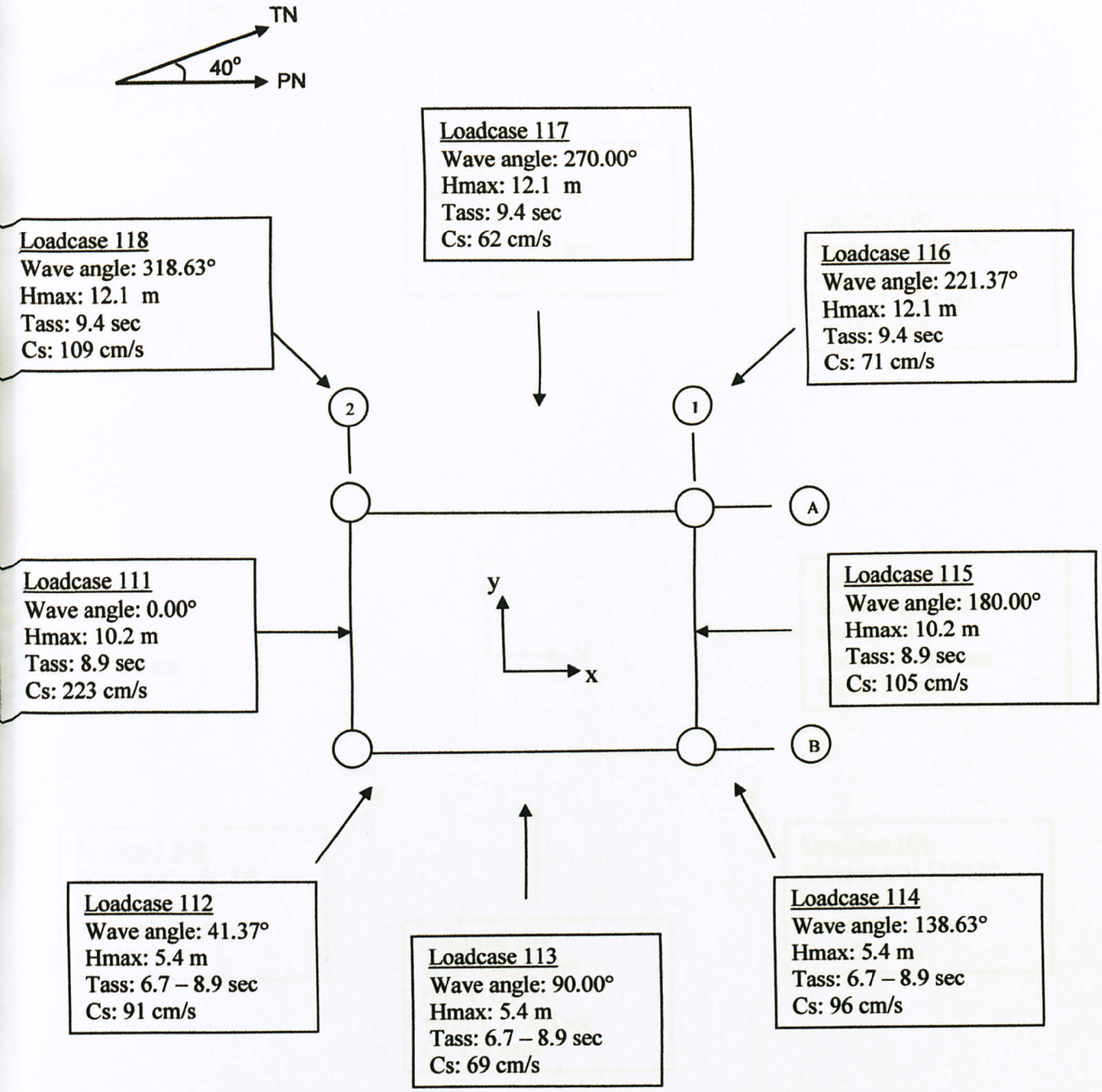


Figure 3.2c: 100-year Storm Wave / Current Direction and Loadings for in-place model

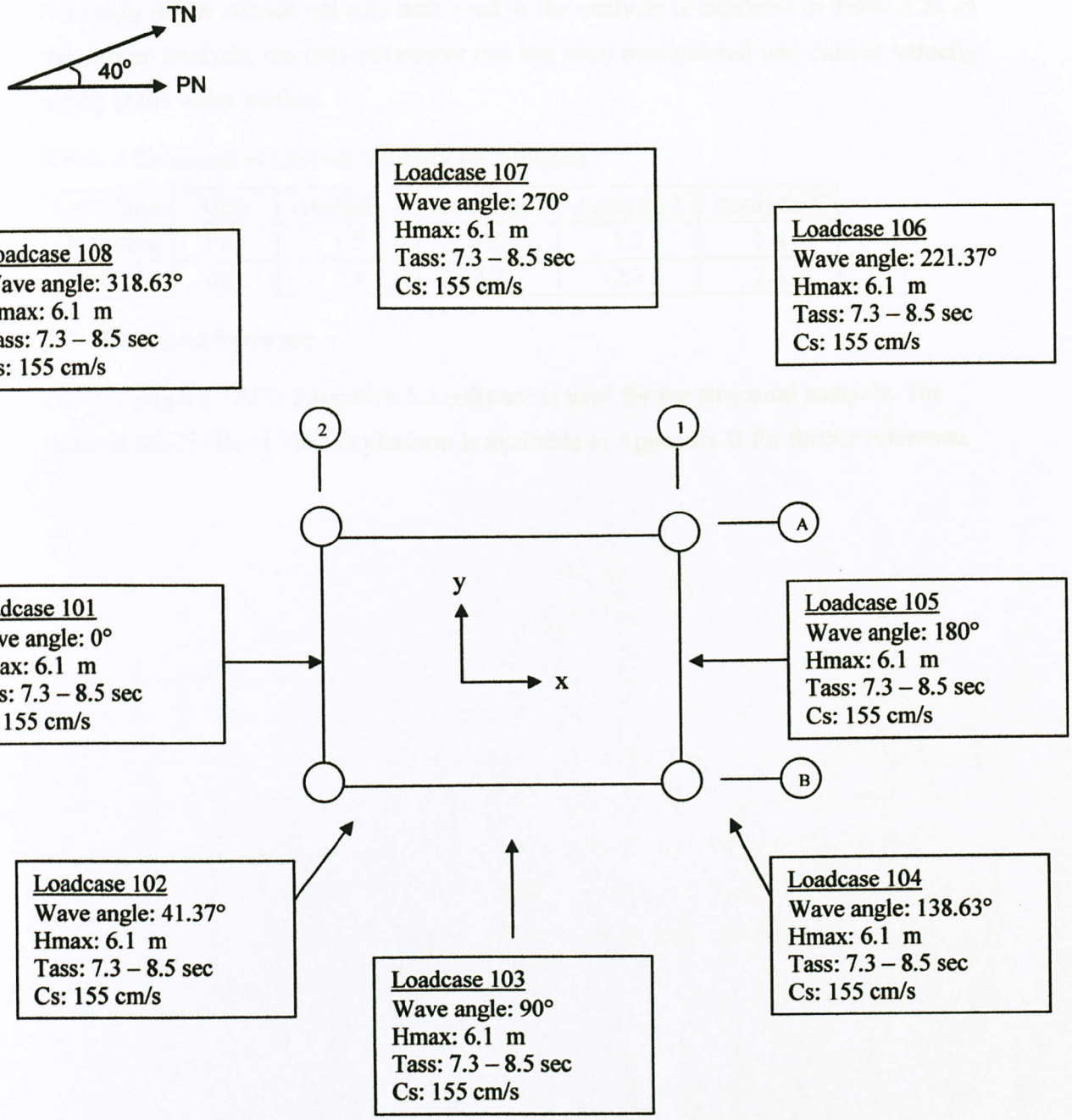


Figure 3.2.d: 1-year Operating Wave / Current Directional and Loadings for In-place Model

Summary of the current velocity data used in the analysis is tabulated in Table 3.2i. In the current analysis, the only parameter that has been manipulated was current velocity acting at the water surface.

Table 3.2i: Range of Current Velocity for Analysis

Condition	Unit	Analysis 1	Analysis 2	Analysis 3	Analysis 4
Operating	m/s	1.5	1.6	1.7	1.8
Storm	m/s	2.1	2.2	2.3	2.4

3.3 Tools and Software

For this project, SACS Executive 5.2 software is used for the structural analysis. The original SACS file of TBG-B platform is available in Appendix B for further reference.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Wind

4.1.1 Basic Load Case Summary (Wind Force)

Table 4.1a below tabulates the basic load cases summary for wind as in original model of TBG-B platform.

Table 4.1a: Basic Wind Load Cases Summary.

Basic Load Case	Wind Load Direction	Unit	In-Place Analysis (2008)
7	X direction (0°)	kN	Fx = 24.96
8	Y direction (90°)	kN	Fy = 19.44

The complete basic load case summary for all loads acting on the TBG-B platform has been attached in Appendix B.3 for further reference. For wind analysis, the wind speed is manipulated from 16 m/s to 22 m/s for operating condition and 36 m/s to 48 m/s for storm condition. Analysis on operating and storm condition is done separately. From the result obtained, the increment of 1 m/s of wind speed caused maximum additional force of 3.28 kN to the platform. Figure 4.1a shows the basic load cases for wind forces that subjected to TBG-B platform.

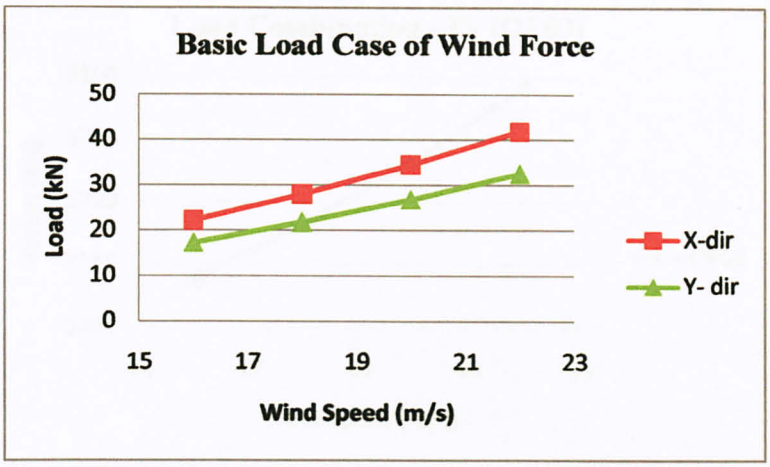


Figure 4.1a: Load Case Summary for Operating Condition

4.1.2 Combined Load Case Summary

Summary of the total combined load cases for original model of TBG-B platform is available in Appendix B.3 for further reference. The following Figure 4.1b to 4.1e shows the load combination for wave height analysis.

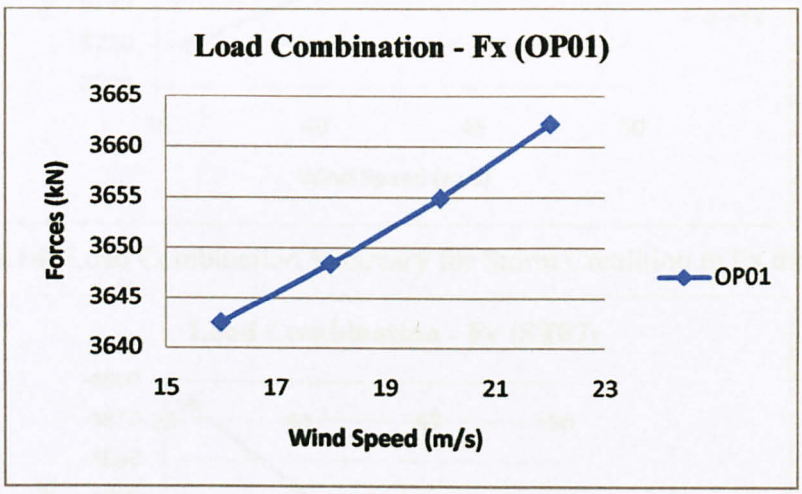


Figure 4.1b: Load Combination Summary for Operating Condition in Fx direction.

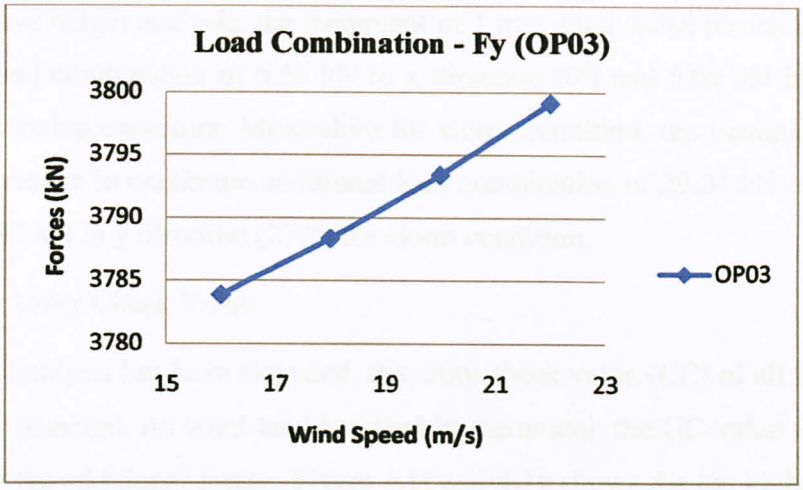


Figure 4.1c: Load Combination Summary for Operating Condition in Fy direction.

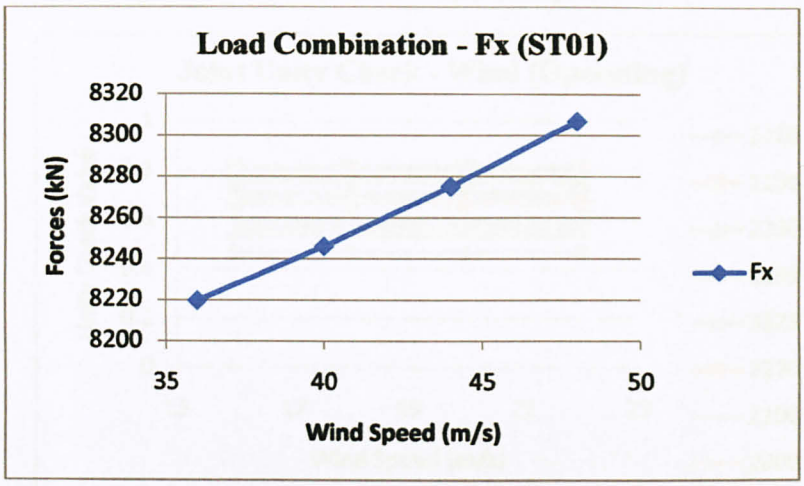


Figure 4.1d: Load Combination Summary for Storm Condition in Fx direction.

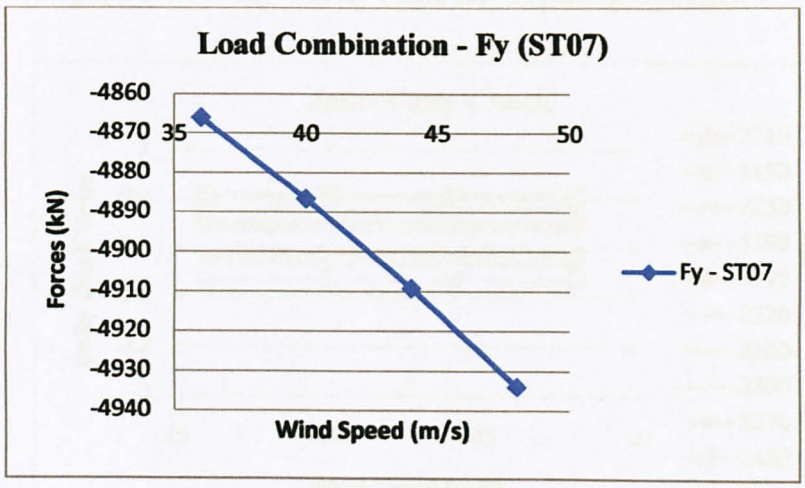


Figure 4.1e: Load Combination Summary for Storm Condition in Fy direction.

From the wave height analysis, the increment of 1 m/s wind speed results in maximum additional load combination of 6.56 kN in x direction (0°) and 5.09 kN in y direction (90°) for operating condition. Meanwhile for storm condition, the increment of 1 m/s wind speed results in maximum additional load combination of 29.04 kN in x direction (0°) and 22.62 kN in y direction (270°) for storm condition.

4.1.3 Joint Unity Check Value

After SACS analysis has been executed, the unity check value (UC) of all the members and joints is obtained. As wind load is added in the model; the UC value for the joints increases by the additional forces. Figure 4.1f and 4.1g shows the ten highest joint UC value for both operating and storm condition respectively.

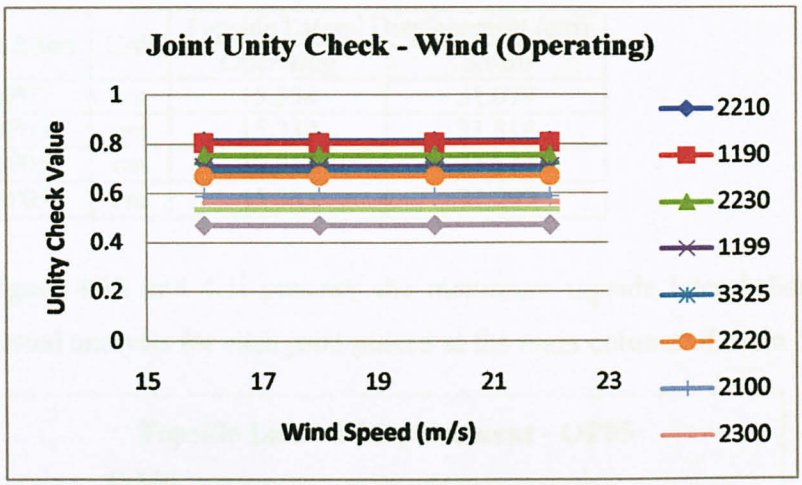


Figure 4.1f: Unity Check Value for Operating Condition.

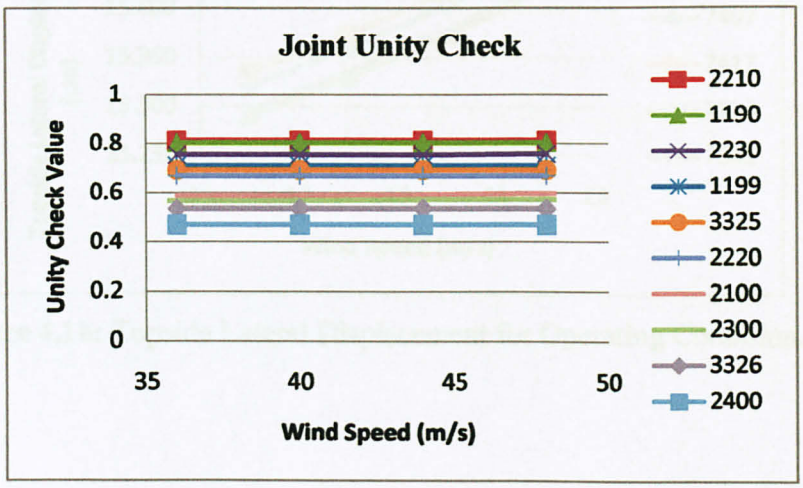


Figure 4.1g: Unity Check Value for storm condition.

For wind analysis, the wind speed is manipulated from 16 m/s to 22 m/s for operating condition and 36 m/s to 48 m/s for storm condition. From the result obtained, the additional forces can be considered as negligible. This is because no increment occurs for the joint unity check even though the force has been added.

4.1.4 Topside Lateral Displacement

The topside lateral displacement is also obtained after executing the SACS analysis. The effect of additional forces of wind results in higher topside lateral displacement. The value of the topside lateral displacement for the original model is tabulated in Table 4.1b below.

Table 4.1b: Topside Lateral Displacement (Original Model)

Joint No.	Condition	Unit	Topside Lateral Displacement (cm)	
			Operating	Storm
7534	OP05	cm	15.358	31.079
7407	OP05	cm	15.339	31.318
7541	OP05	cm	15.315	31.114
7417	OP05	cm	15.353	31.297

Meanwhile, Figure 4.1h and 4.1i presents the maximum topside lateral displacement from the conducted analysis for each joint placed at the main column of main deck.

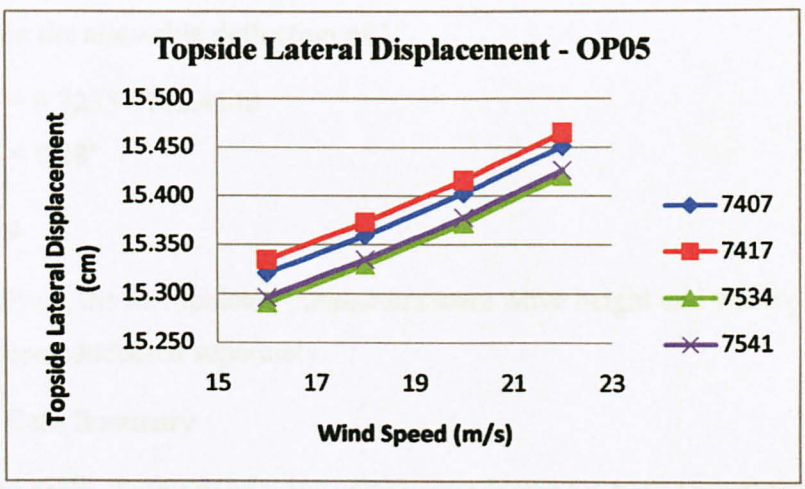


Figure 4.1h: Topside Lateral Displacement for Operating Condition.

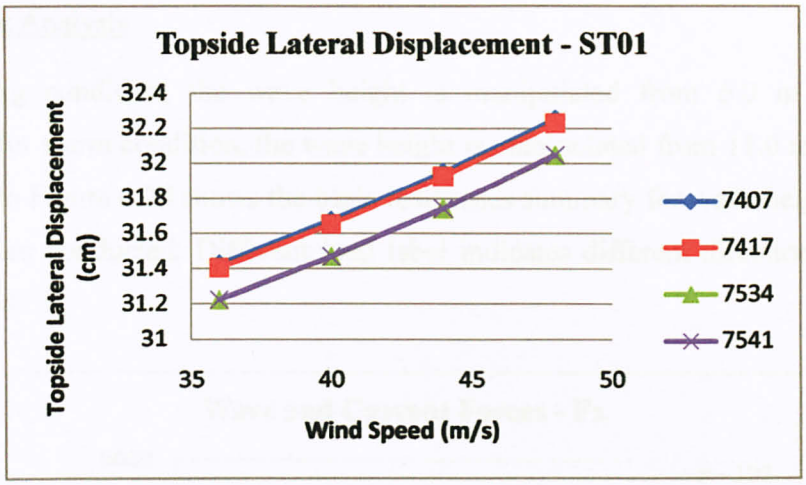


Figure 4.1i: Topside Lateral Displacement for Storm Condition.

From the result obtained, it shows that the average increment of 1 m/s of wind speed has caused maximum additional topside lateral displacement of 0.08 cm for operating condition and 0.27 cm for storm condition.

The maximum resultant lateral topside displacement at the top of Wireline Deck is found to be 32.25 cm. This maximum displacement occurs in load case ST01 at joint 7407 (Wireline Deck), with the lever arm relative to mudline to be 102.414 m. This corresponds to a deflection of 0.18° relative to the vertical axis as calculated below which is within the allowable deflection of 1°.

$$\tan \Theta = 0.3235 / 102.4140$$

$$\Theta = 0.18°$$

4.2 Wave

For wave analysis, the manipulated parameters were wave height and wave period which have been conducted separately.

4.2.1 Load Case Summary

The basic load cases summary of wave and current forces for both operating and storm condition in original model of TBG-B platform is available in Appendix B.3 for further reference.

Wave Height Analysis

For operating condition, the wave height is manipulated from 6.0 m to 7.5 m. Meanwhile for storm condition, the wave height is manipulated from 11.0 m to 12.5 m. Figure 4.2a to Figure 4.2d shows the basic load cases summary for wave height analysis that have been conducted. Different load label indicates different directions of forces being applied.

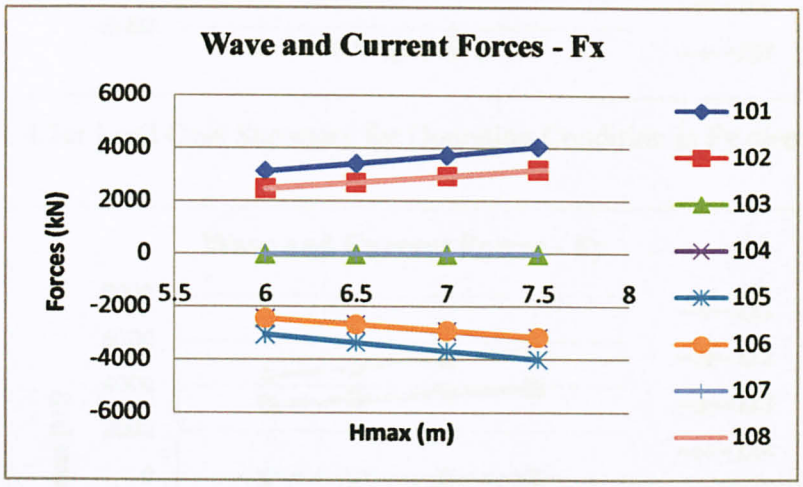


Figure 4.2a: Load Case Summary for Operating Condition in Fx direction

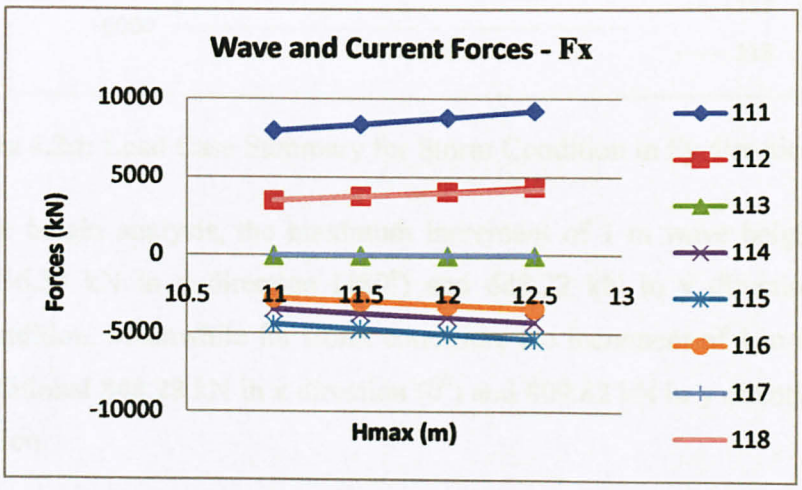


Figure 4.2b: Load Case Summary for Storm Condition in Fx direction

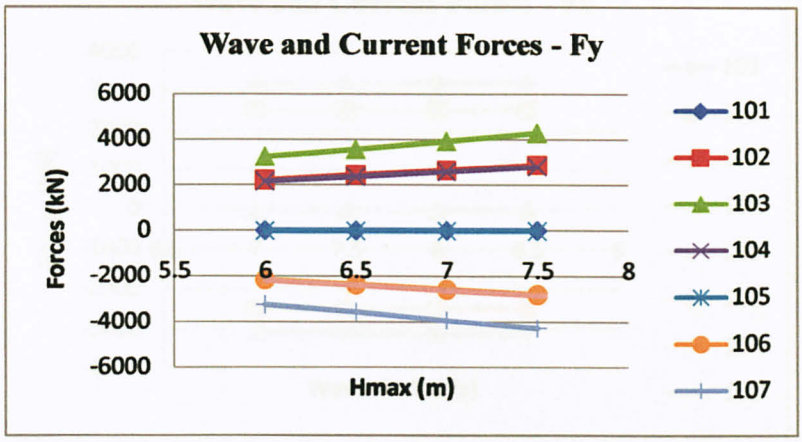


Figure 4.2c: Load Case Summary for Operating Condition in Fy direction.

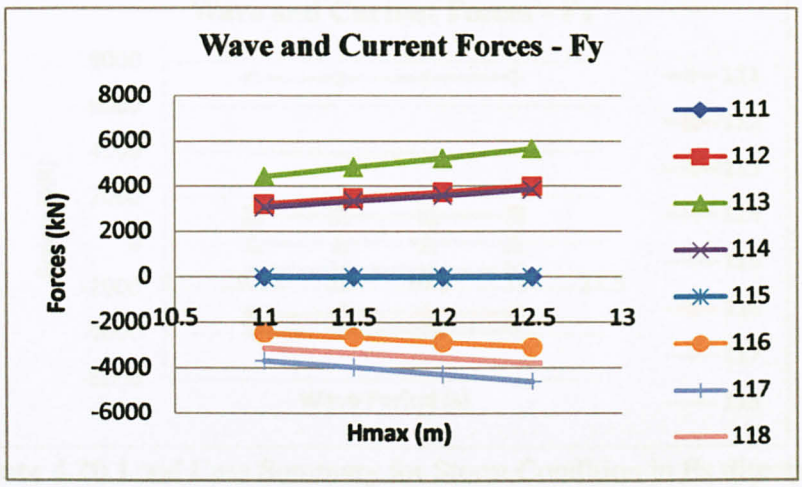


Figure 4.2d: Load Case Summary for Storm Condition in Fy direction.

For the wave height analysis, the maximum increment of 1 m wave height results in additional 636.34 kN in x direction (180°) and 688.22 kN in y direction (90°) for operating condition. Meanwhile for storm condition, the increment of 1 m wave height results in additional 848.28 kN in x direction (0°) and 809.82 kN in y direction (90°) for storm condition.

Wave Period Analysis

For wave period analysis, the wave height is manipulated from 6.0 m to 7.5 m for operating condition and 11.0 m to 12.5 m for storm condition. Figure 4.2e to Figure 4.2h shows the load case summary for wave period analysis that has been conducted.

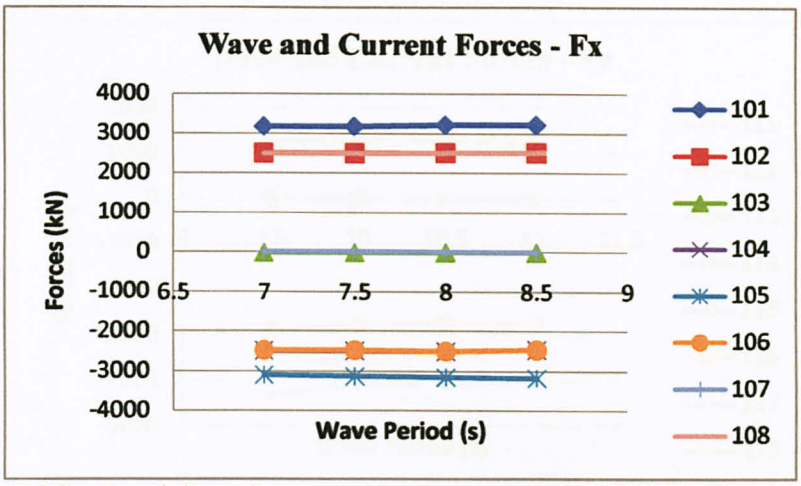


Figure 4.2e: Load Case Summary for Operating Condition in Fx direction

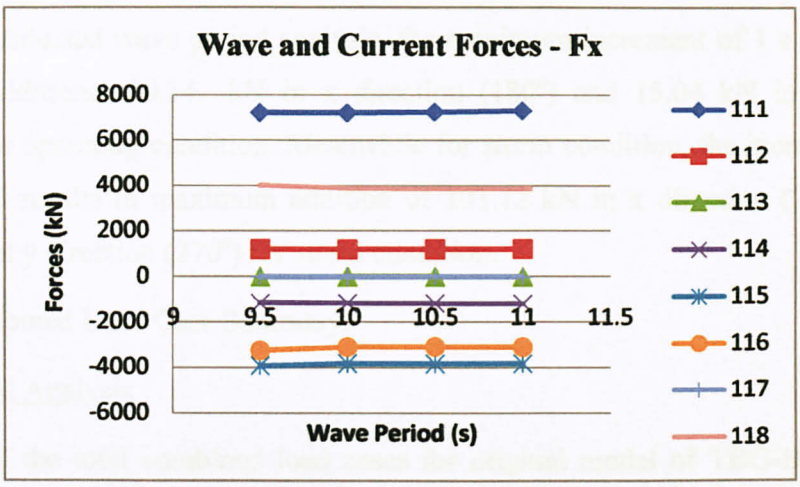


Figure 4.2f: Load Case Summary for Storm Condition in Fx direction

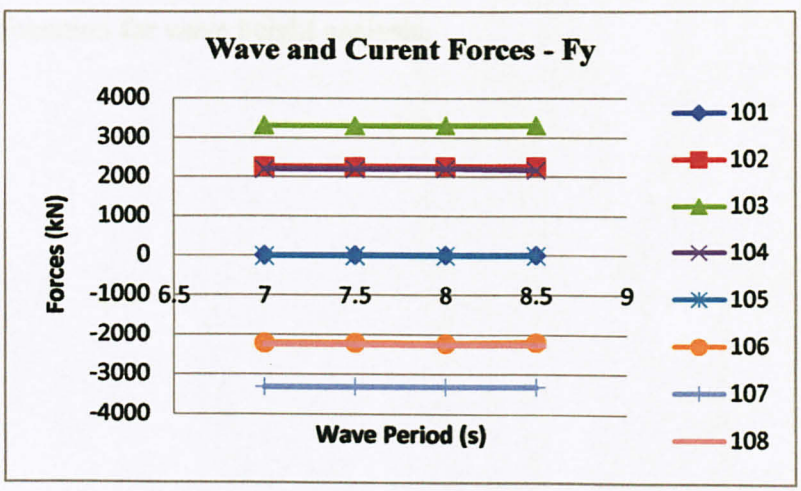


Figure 4.2g: Load Case Summary for Operating Condition in Fy direction.

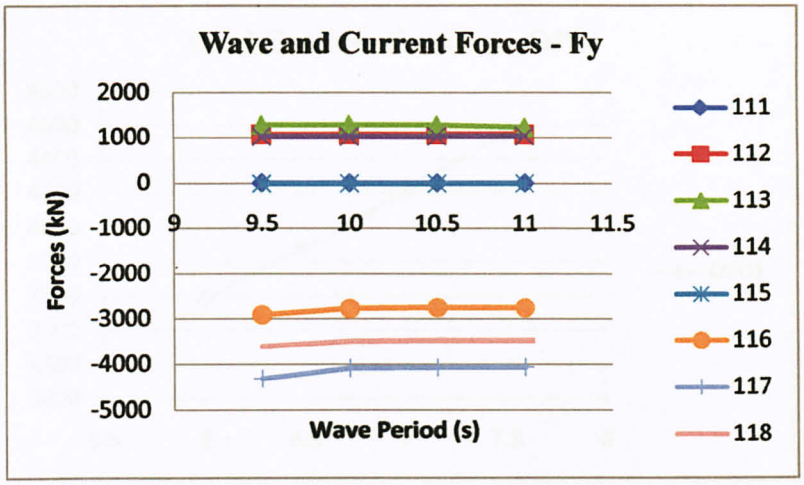


Figure 4.2h: Load Case Summary for Storm Condition in Fy direction.

From the conducted wave period analysis, the maximum increment of 1 s wave height results in additional 50.14 kN in x direction (180°) and 15.04 kN in y direction (221.37°) for operating condition. Meanwhile for storm condition, the increment of 1 s wave period results in maximum addition of 103.12 kN in x direction (221.37°) and 169.96 kN in y direction (270°) for storm condition.

4.2.2 Combined Load Case Summary.

Wave Height Analysis

Summary of the total combined load cases for original model of TBG-B platform is available in Appendix B.3 for further reference. The following Figure 4.2i to 4.2l shows the load combination for wave height analysis.

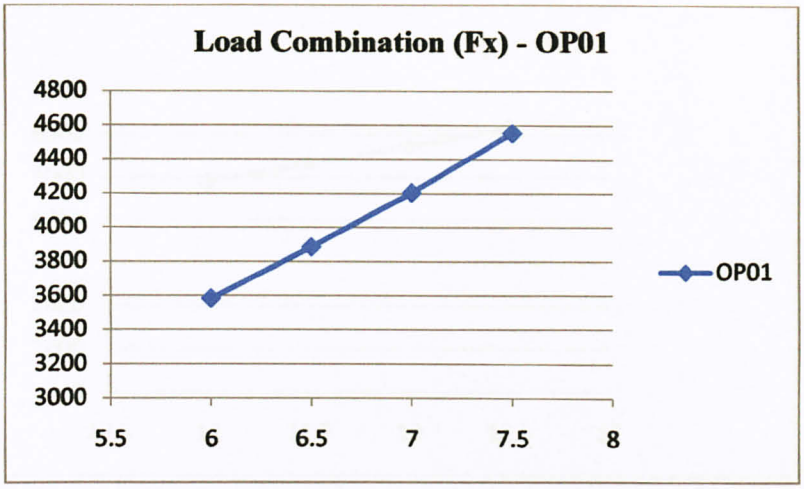


Figure 4.2i: Load Combination Summary for Operating Condition in Fx direction.

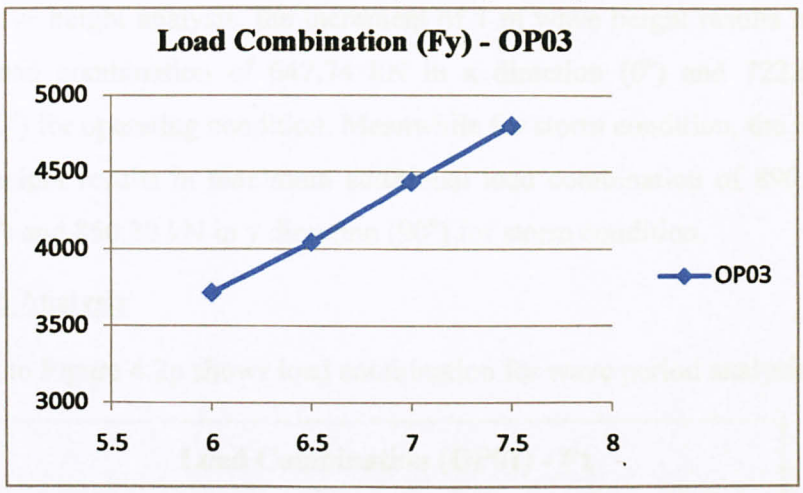


Figure 4.2j: Load Combination Summary for Operating Condition in Fy direction.

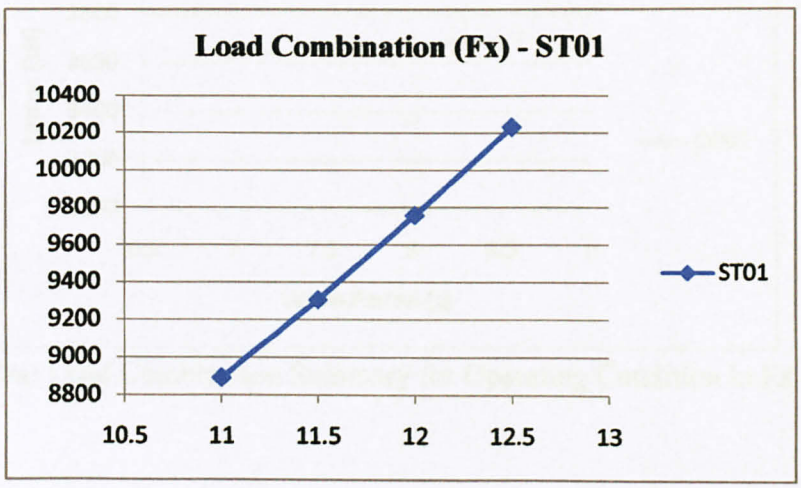


Figure 4.2k: Load Combination Summary for Storm Condition in Fx direction.

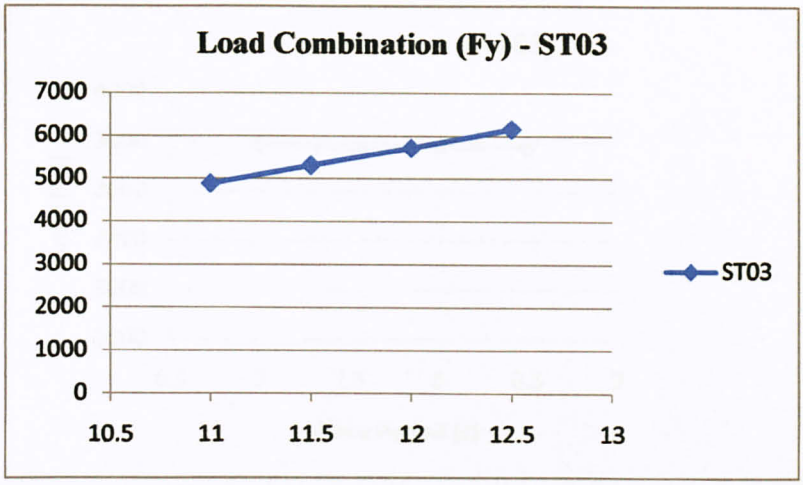


Figure 4.2l: Load Combination Summary for Storm Condition in Fy direction.

From the wave height analysis, the increment of 1 m wave height results in maximum additional load combination of 647.74 kN in x direction (0°) and 722.62 kN in y direction (90°) for operating condition. Meanwhile for storm condition, the increment of 1 m wave height results in maximum additional load combination of 890.68 kN in x direction (0°) and 850.30 kN in y direction (90°) for storm condition.

Wave Period Analysis

Figure 4.2m to Figure 4.2p shows load combination for wave period analysis.

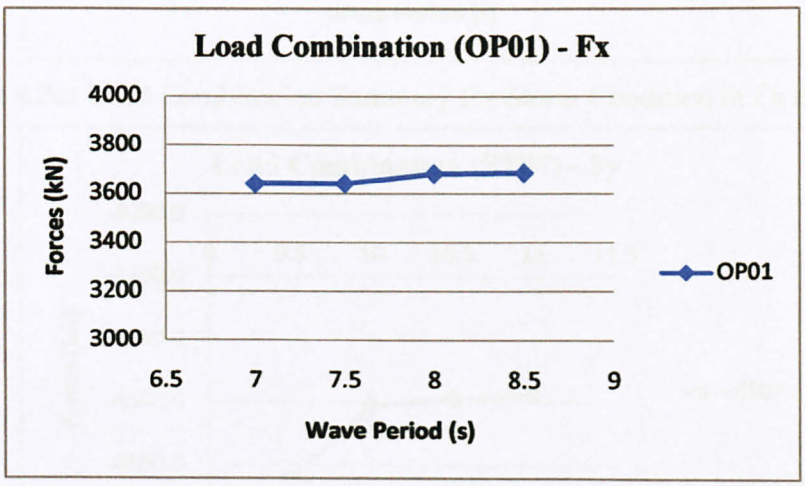


Figure 4.2m: Load Combination Summary for Operating Condition in Fx direction.

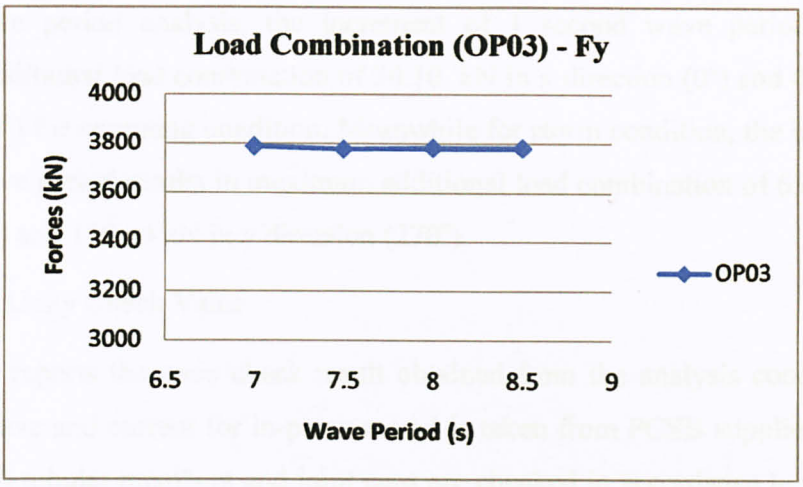


Figure 4.2n: Load Combination Summary for Operating Condition in Fy direction.

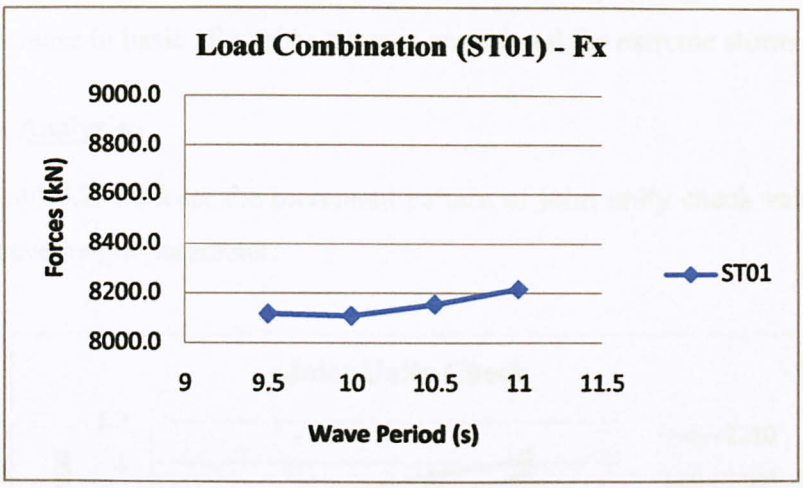


Figure 4.2o: Load Combination Summary for Storm Condition in Fx direction.

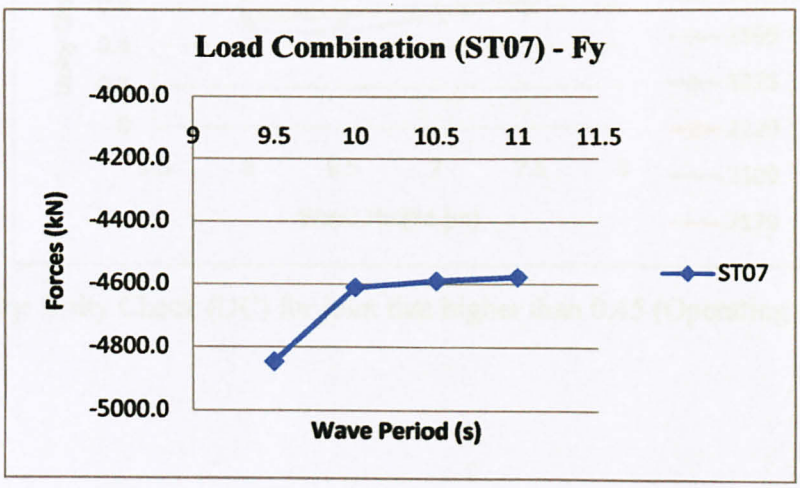


Figure 4.2p: Load Combination Summary for Storm Condition in Fy direction.

For the wave period analysis, the increment of 1 second wave period results in maximum additional load combination of 30.10 kN in x direction (0°) and 4.22 kN in y direction (90°) for operating condition. Meanwhile for storm condition, the increment of 1 second wave period results in maximum additional load combination of 65.78 kN in x direction (0°) and 178.44 kN in y direction (270°).

4.2.3 Joint Unity Check Value

This section reports the code check result obtained from the analysis conducted. The criteria of wave and current for in-place model is taken from PCSB supplied metocean data [10]. All tubular members and joint cans are checked in accordance to API RP2A-WSD [4]. Basic allowable stresses are used for normal operating conditions. A one-third (1/3) increase in basic allowable stress is considered for extreme storm conditions.

Wave Height Analysis

Figure 4.2q and 4.2r indicate the increment pattern of joint unity check value from the analysis of wave height parameter.

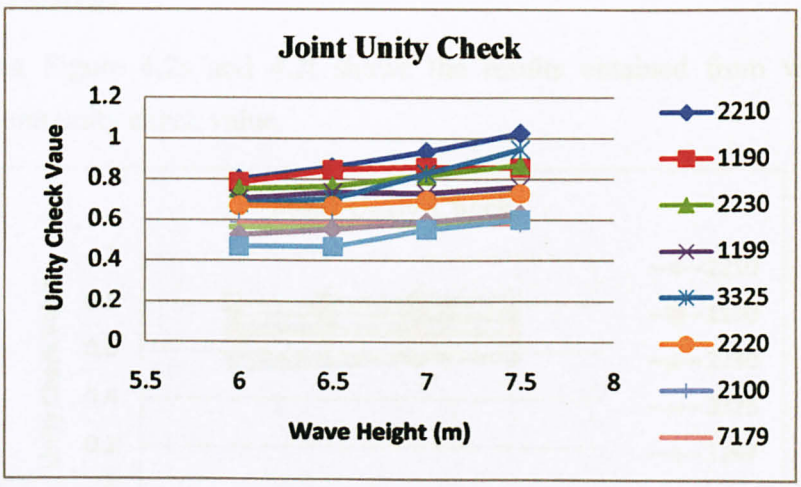


Figure 4.2q: Unity Check (UC) for joint that higher than 0.45 (Operating Condition)

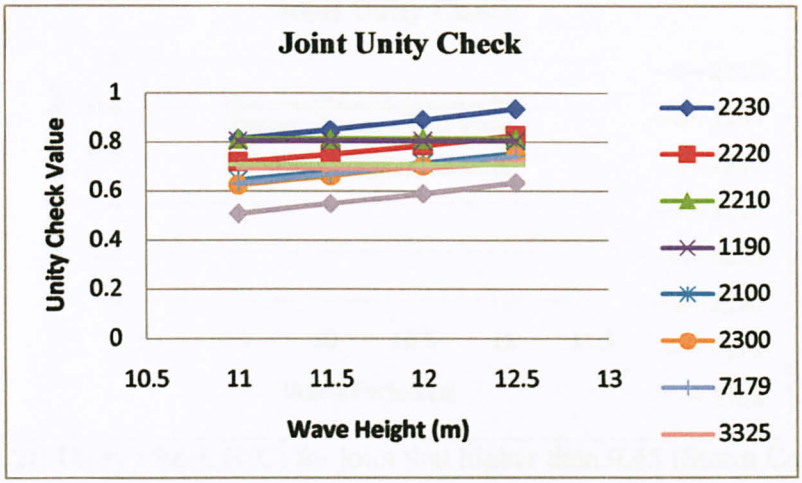


Figure 4.2r: Unity Check (UC) for joint that higher than 0.45 (Storm Condition)

For the conducted analysis, it shows that an increment of 1 m wave height caused maximum additional unity check value of 0.16 at joint 2210 for operating condition. Meanwhile for storm condition, the increment of 1 m wave height results in maximum additional of 0.08 at joint 2230 for storm condition.

Wave Period Analysis

The following Figure 4.2s and 4.2t shows the results obtained from wave period analysis for joint unity check value.

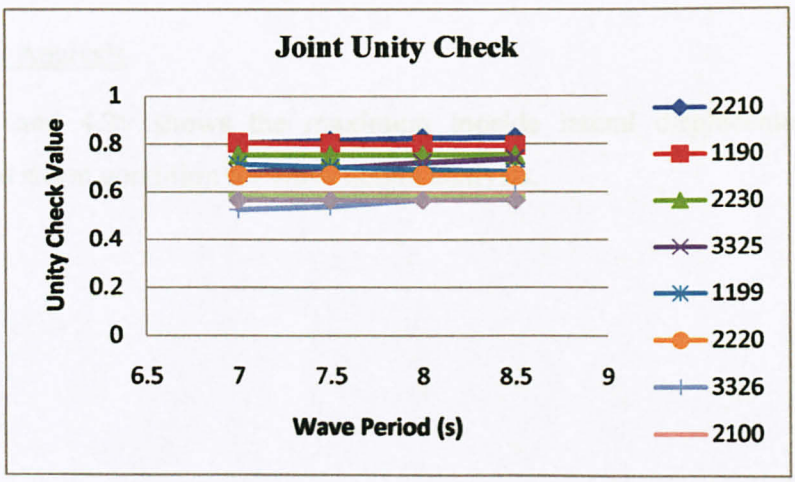


Figure 4.2s: Unity Check (UC) for joint that higher than 0.45 (Operating Condition)

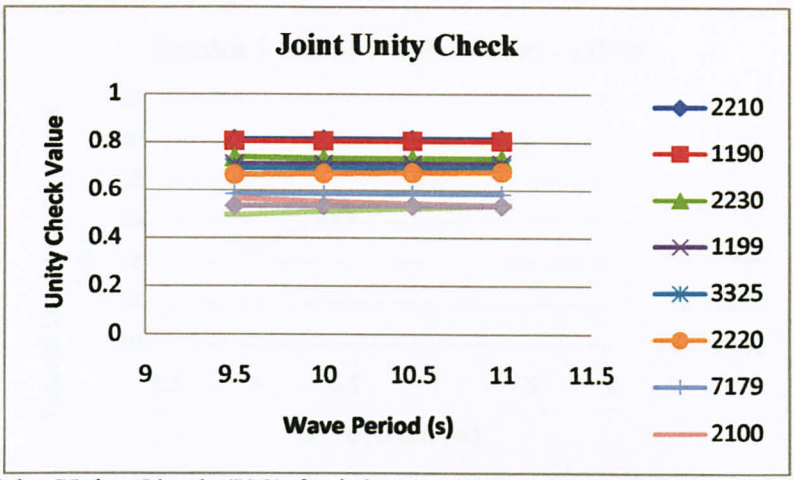


Figure 4.2t: Unity Check (UC) for joint that higher than 0.45 (Storm Condition)

For the wave period analysis, the increment of 1 second wave period results in maximum additional of 0.04 at joint 3326 for operating condition. Meanwhile for storm condition, the increment of 1 second wave period results in maximum addition of 0.02 for storm condition at joint 3909.

4.2.4 Maximum Topside Lateral Displacement

In the original model, the maximum resultant lateral topside displacement at the top of Main Deck is found to be 31.32 cm for under SX02 condition. The lever arm relative to mudline is 102.414 m. This corresponds to a deflection of 0.175° for original model relative to the vertical axis. The original model is within the allowable deflection of 1°.

Wave Height Analysis

Figure 4.2u and 4.2v shows the maximum topside lateral displacement for both operating and storm condition for wave height analysis.

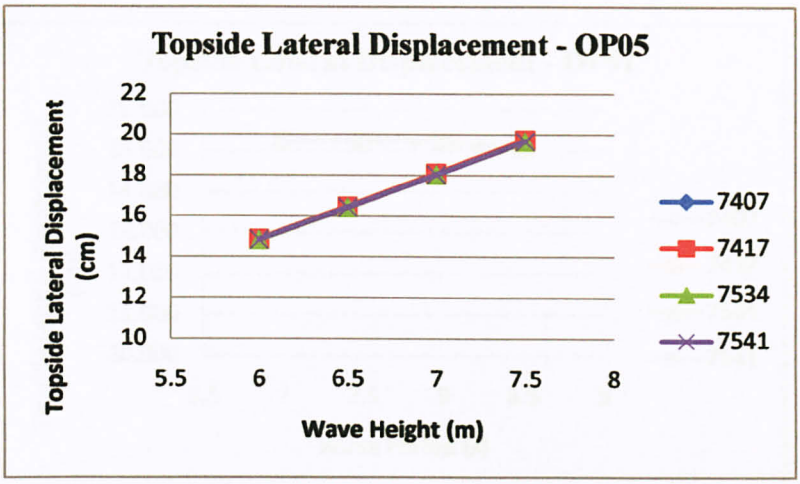


Figure 4.2u: Maximum Topside Lateral Displacement (Operating Condition)

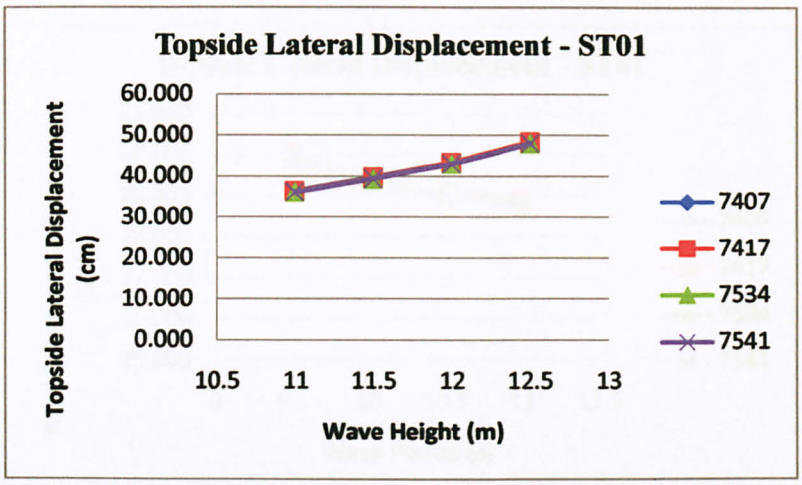


Figure 4.2v: Maximum Topside Lateral Displacement (Storm Condition)

From the result obtained, the increment of 1 m wave height results in maximum addition of 3.24 cm for topside lateral displacement under operating condition. Meanwhile for storm condition, the increment of 1 m wave height results in maximum additional topside lateral displacement of 7.92 cm for storm condition.

Wave Period Analysis

Figure 4.2w and 4.2x show the maximum topside lateral displacement for both operating and storm condition for wave period analysis.

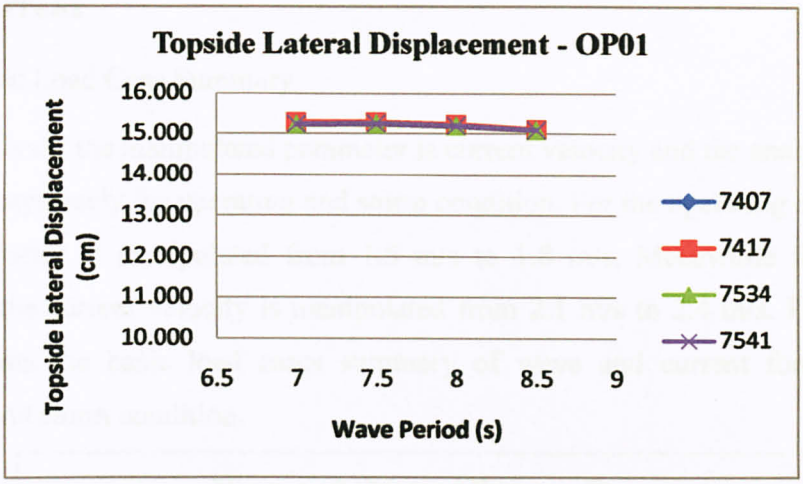


Figure 4.2w: Maximum Topside Lateral Displacement (Operating Condition)

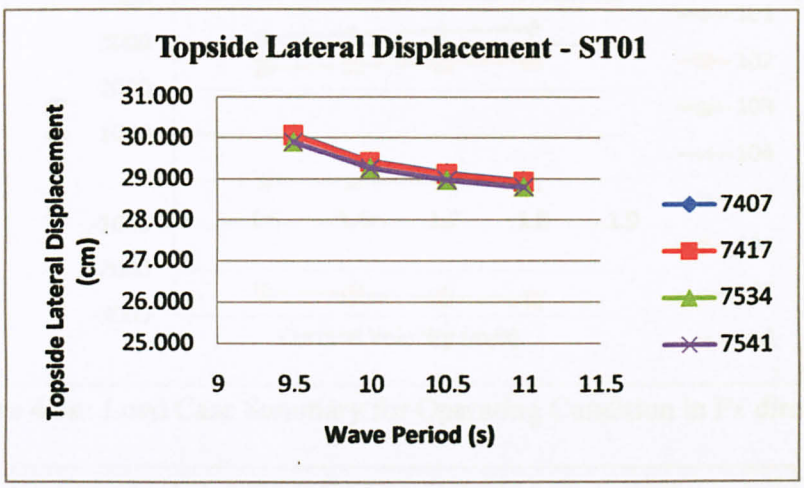


Figure 4.2x: Maximum Topside Lateral Displacement (Storm Condition)

For the wave period analysis, the increment of 1 second wave period results in decreasing topside lateral displacement of 0.11 cm for operating condition. Meanwhile for storm condition, the increment of 1 second wave period results in additional topside lateral displacement of 0.75 cm for storm condition.

4.3 Current

4.3.1 Basic Load Case Summary

For the analysis, the manipulated parameter is current velocity and the analysis has been conducted separately for operating and storm condition. For the operating condition, the current velocity is manipulated from 1.5 m/s to 1.8 m/s. Meanwhile for the storm condition, the current velocity is manipulated from 2.1 m/s to 2.4 m/s. Figure 4.3a to 4.3d presents the basic load cases summary of wave and current forces for both operating and storm condition.

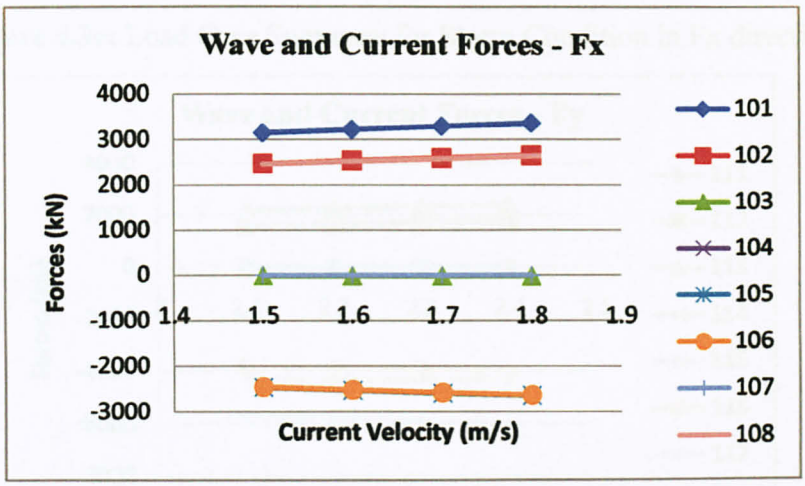


Figure 4.3a: Load Case Summary for Operating Condition in Fx direction.

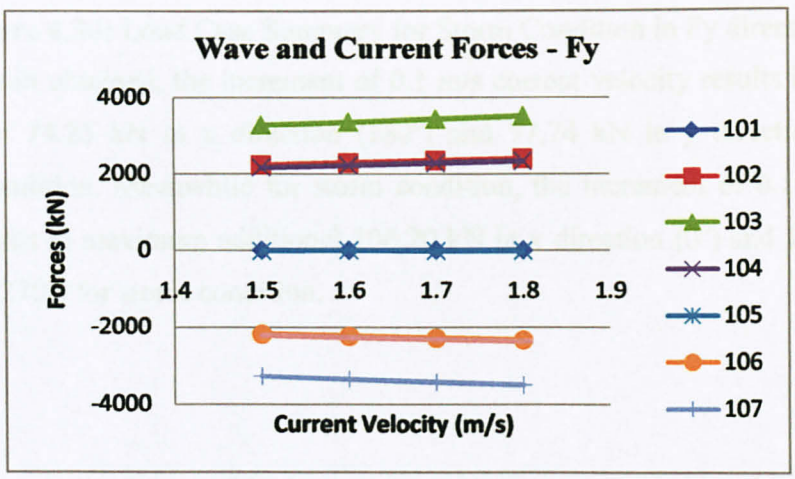


Figure 4.3b: Load Case Summary for Storm Condition in Fy direction.

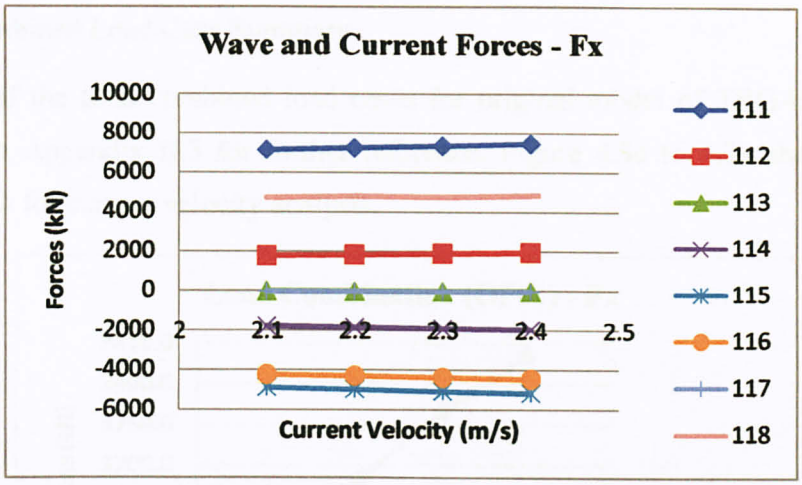


Figure 4.3c: Load Case Summary for Storm Condition in Fx direction.

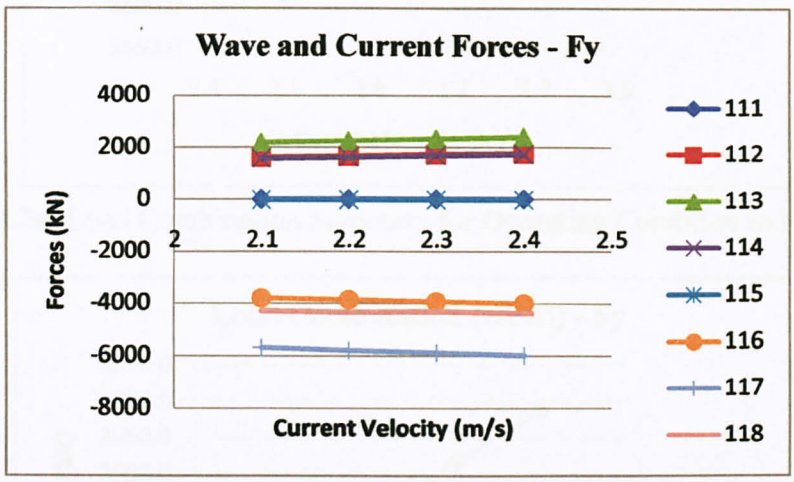


Figure 4.3d: Load Case Summary for Storm Condition in Fy direction.

From the result obtained, the increment of 0.1 m/s current velocity results in maximum additional of 74.25 kN in x direction (180°) and 77.74 kN in y direction (90°) for operating condition. Meanwhile for storm condition, the increment of 0.1 m/s current velocity results in maximum additional 106.20 kN in x direction (0°) and 100.61 kN in y direction (270°) for storm condition.

4.3.2 Combined Load Case Summary

Summary of the total combined load cases for original model of TBG-B platform is available in Appendix B.3 for further reference. Figure 4.3e to 4.3h shows the load combination for current velocity analysis.

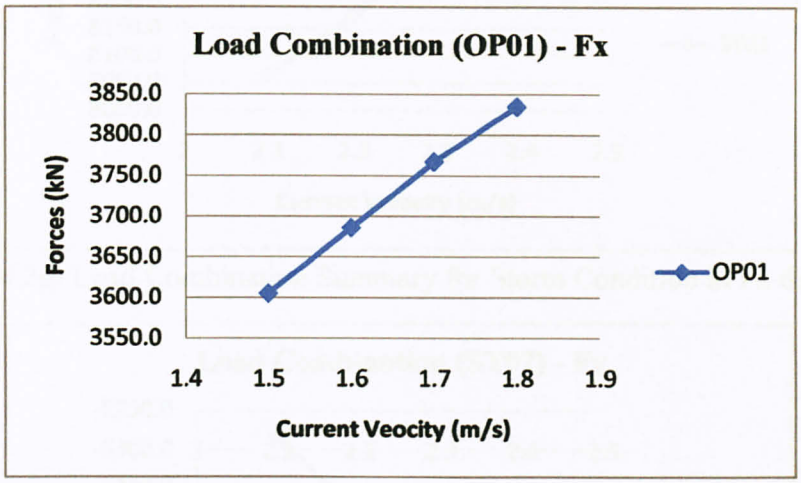


Figure 4.3e: Load Combination Summary for Operating Condition in Fx direction.

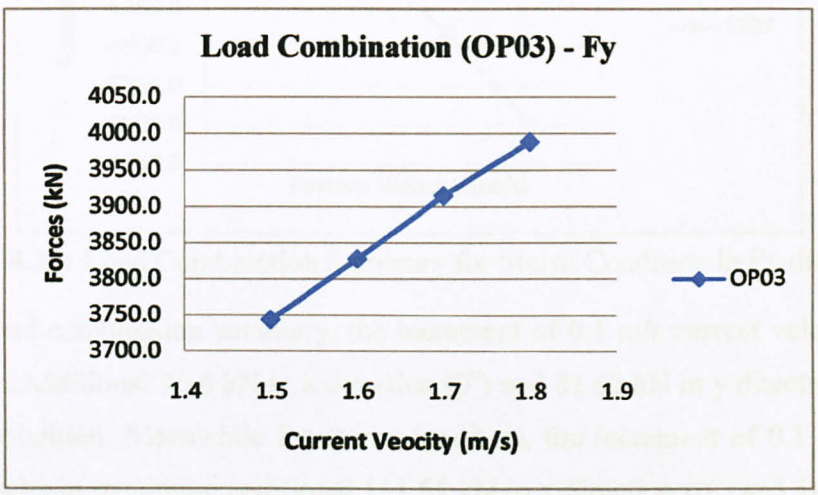


Figure 4.3f: Load Combination Summary for Operating Condition in Fy direction.

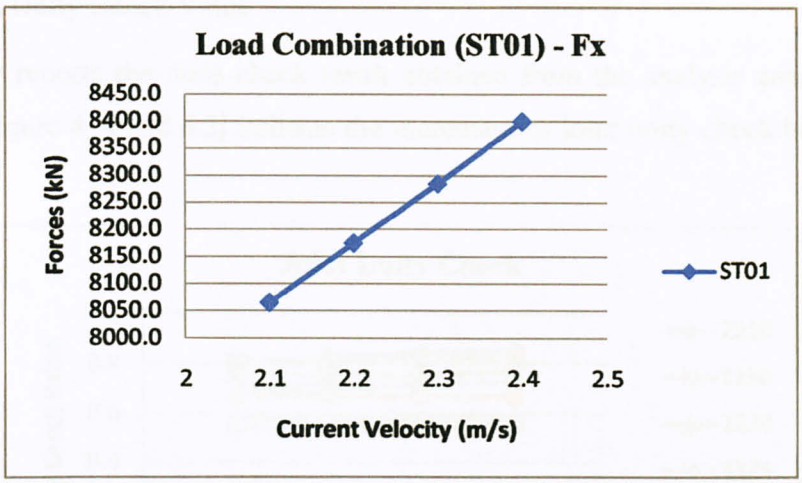


Figure 4.3g: Load Combination Summary for Storm Condition in Fx direction.

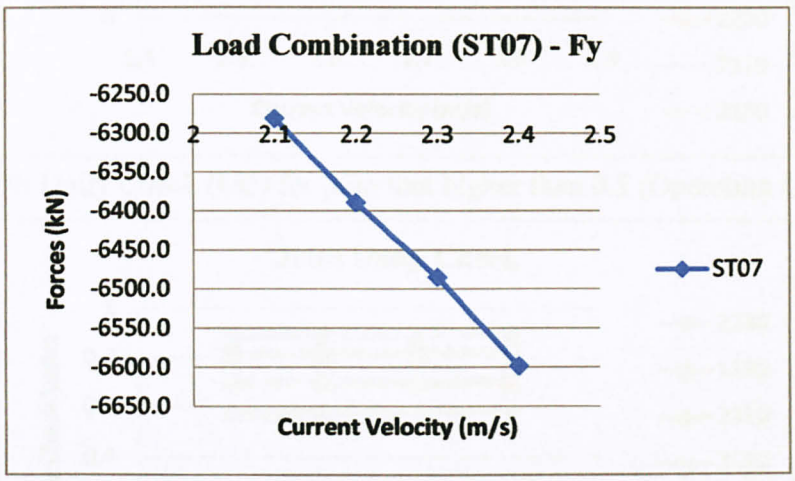


Figure 4.3h: Load Combination Summary for Storm Condition in Fy direction.

From the load combination summary, the increment of 0.1 m/s current velocity results in maximum additional 76.6 kN in x direction (0°) and 81.62 kN in y direction (90°) for operating condition. Meanwhile for storm condition, the increment of 0.1 m/s current velocity results in maximum additional 111.51 kN in x direction (0°) and 105.64 kN in y direction (270°).

4.3.3 Joint Unity Check Value

This section reports the code check result obtained from the analysis conducted. The following Figure 4.3i and 4.3j indicate the increment of joint unity check between each analysis.

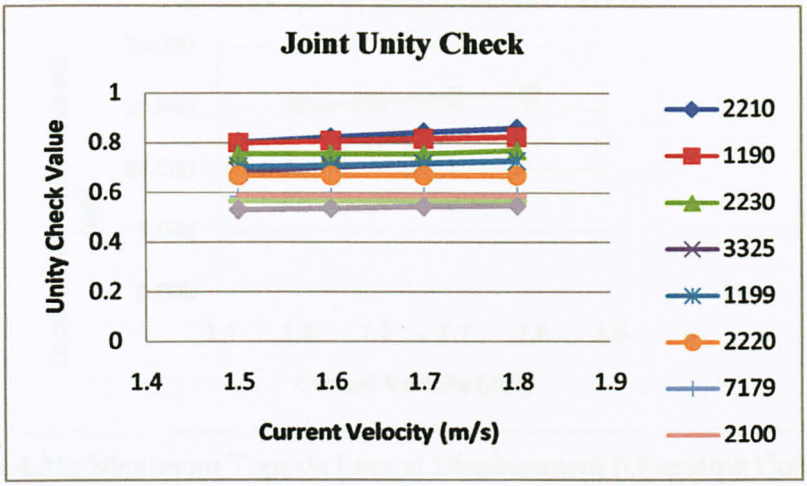


Figure 4.3i: Unity Check (UC) for joint that higher than 0.5 (Operating Condition)

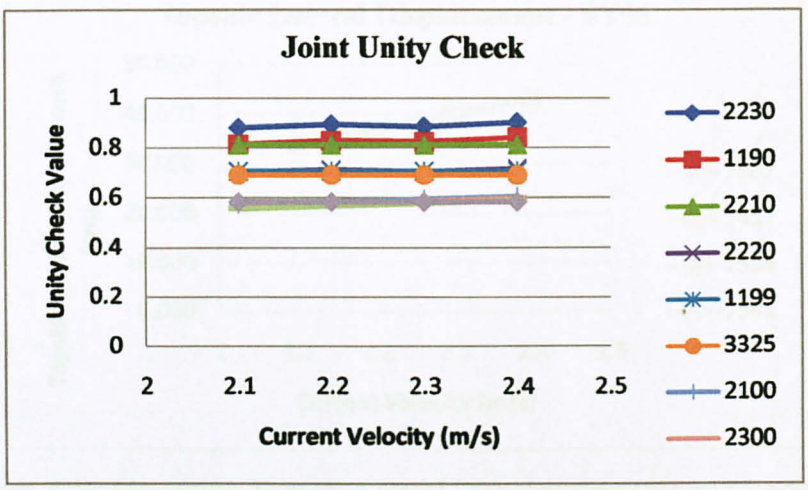


Figure 4.3j: Unity Check (UC) for joint that higher than 0.5 (Storm Condition)

From the code check analysis, the increment of 0.1 m/s current velocity results in maximum additional unity check value of 0.02 for operating condition at joint 2210. Meanwhile for storm condition, the increment of 0.1 m/s current velocity results in maximum additional load combination of 0.01 for storm condition at joint 2230.

4.3.4 Topside Lateral Displacement

Figure 4.3k and 4.3l shows the maximum topside lateral displacement for both operating and storm condition for current velocity analysis.

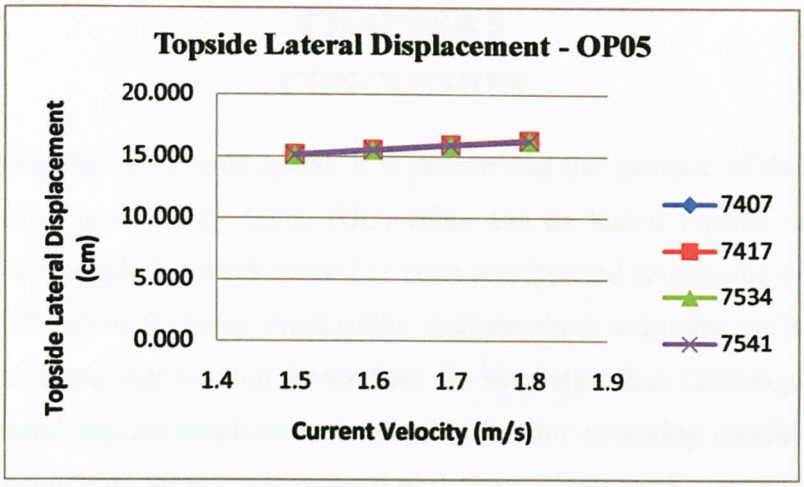


Figure 4.3k: Maximum Topside Lateral Displacement (Operating Condition)

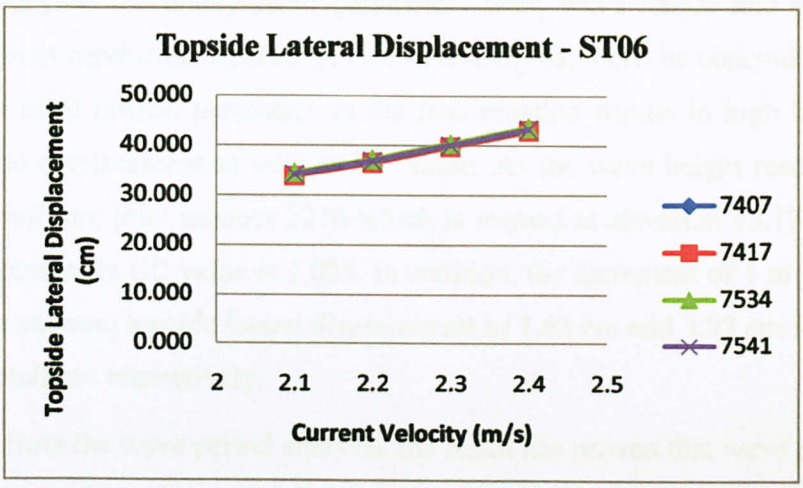


Figure 4.3l: Maximum Topside Lateral Displacement (Storm Condition)

From the conducted analysis, the increment of 0.1 m/s current velocity results in maximum additional topside lateral displacement of 0.37 cm for operating condition under OP05 (180°). Meanwhile for storm condition, the increment of 0.1 m/s current velocity results in maximum additional topside lateral displacement of 3.02 cm for storm condition under ST06 (221.37°).

CHAPTER 5
CONCLUSION

From the manipulation of wind speed, it is proven that the increase of the wind speed has caused raise in the unity check (UC) value and its lateral topside displacement. However, even though the wind speed has been manipulated to extreme condition, the platform is still safe as the unity check of the steel members and joints are below 1. This shows that the increment in wind forces does not severely affect TBG-B platform. The maximum lateral topside displacements are 0.04 cm for operating condition and 0.27 cm for storm condition for every increment of 0.1 m/s wind speed.

For wave analysis, the manipulated parameters were wave height and wave period which have been conducted separately. From the analysis, it can be concluded that wave height is the most critical parameter as the manipulation results in high increment of topside lateral displacement as well as UC value. As the wave height reach 7.5 m for operating condition; joint number 2210 which is located at elevation 13.179 below sea level fails because its UC value is 1.025. In addition, the increment of 1 m wave height has caused maximum topside lateral displacement of 1.63 cm and 3.97 cm for operating and storm condition respectively.

Meanwhile, from the wave period analysis, the result has proven that wave period is not a critical parameter as the manipulation results in small increment of topside lateral displacement and UC value of steel members and joints. The increment of 1 second of wave period has no significant increment in code check of joint and steel member. Furthermore, the increment of 1 second of wave period also has caused decrement in topside lateral displacement of 0.06 cm for operating condition and 0.38 cm for storm condition respectively.

For current analysis, the manipulated parameter was current velocity. From the analysis, it can be concluded that current velocity is also not a critical parameter as the increment of current velocity results in small increment of topside lateral displacement and UC value.

CHAPTER 6
REFERENCES

[1] *'Fixed Platform'* http://www.globalsecurity.org/military/systems/ship/platform-fixed.htm.

[2] RNZ, 'Structural In-place Analysis Report for TBG-B Platform', Doc. No.: P5178-ST-RP-019A.

[3] Mihail POPESCU and Adrian SIMBOTIN.(2002) 'Hydrodynamic Loads on Offshore Platform Structures'. *University of Constanta, Romania*, ISSN-12223-7221.

[4] M.Efthymiou and C.G.Graham, "Environmental Forces on Offshore Structures and Their Prediction", *Environmental Loading on Fixed Offshore Platforms,* Vol. 26, 1990, pp. 293-320

[5] RNZ, 'Structural Integrity Assessment Basis for Provision of Updating SACS Model and Static Inplace Analysis for 20 SBO Platforms for PETRONAS Carigali Sdn. Bhd, Sabah Operation (PCSB-SBO)', Doc. No.: P5178-ST-DB-0001.

[6] S.K Chakrabarti, "Handbook of Offshore Engineering", Vol. 1, First Edition 2005.

[7] S.K Chakrabarti, "Hydrodynamics of Offshore Structures", First Edition 1987.

[8] *'Stream Function Wave Theory'* by Robert A. Dalrymple , Center for Applied Coastal Research, University of Delaware, Newark DE 19716, USA. http://www.coastal.udel.edu/faculty/rad/streamless.html

[9] API, 'Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design', API RP2A-WSD 21st Edition, December 2000.

[10] Petronas, 'Design of Fixed Offshore Structures', PTS 20.073, December 1983 and 'Supplementary to PTS 20.073', Rev. 4, August 2005.

[11] Metocean Design Base Data Ref: DFSP/Erb West-Tembungo dated 25th Aug 2008.

APPENDICES

APPENDIX A

APPENDIX A.1: Milestone for the First Semester of 2 Semester Final Year Project

APPENDIX A.2: Milestone for the Second Semester of 2 Semester Final Year Project.

APPENDIX A.1: Milestone for the First Semester of 2 Semester Final Year Project

Semester 1 - January 2009

No.	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Selection of Project Topic	■														
2	Jurnal Research		■	■	■											
3	Submission of Jurnals				○											
4	Study Wave Behaviour and Its Effect to Offshore Structure					■	■									
5	Submission of Progress Report						○									
6	Structural Analysis (SACS Software)- Wind Force							■	■	■	■	■				
7	Submission of Interim Report Final Draft												○			
8	Oral Presentation															○

○ Milestone

■ Process

APPENDIX A.2: Milestone for the Second Semester of 2 Semester Final Year Project.

Semester 2 - July 2009

No.	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Continue with Analysis (SACS Software)-Wave and Current forces	■	■	■											
2	Submission of Progress Report						○								
3	Result Gathering and Analysis				■	■	■	■							
4	Discussion and Conclusion of Project Research								■	■	■	■			
5	Poster Exhibition										○				
6	Submission of Dissertation (soft bound)											○			
7	Oral Presentation														○
8	Submission of Project Dissertation (Hard Bound)														○

○ Milestone

■ Process

APPENDIX B – SACS Software (Original Model)

APPENDIX B.1: TBG-B Platform Model Plots

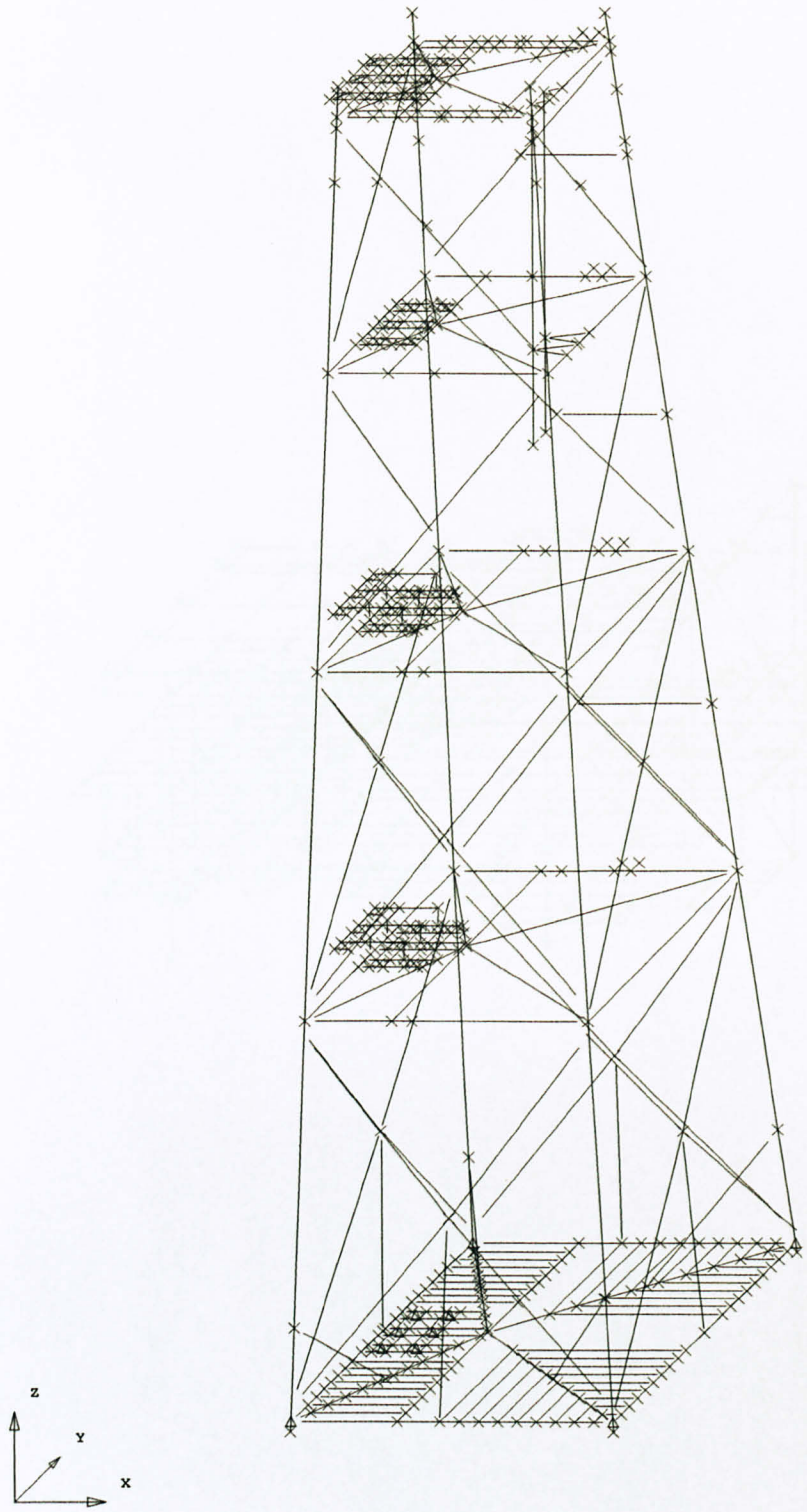
APPENDIX B.2: SACS Input File

APPENDIX B.3: SACS Output File

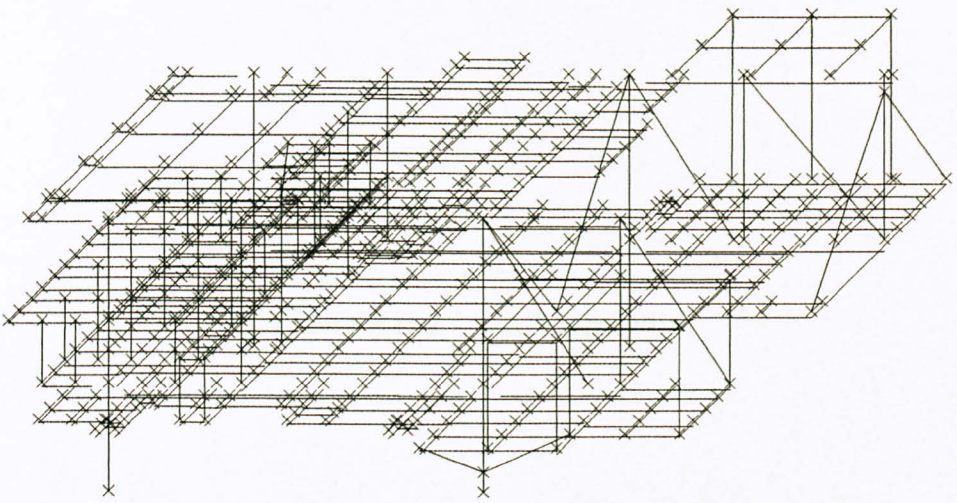
APPENDIX B.1: TBG-B Platform Model Plots

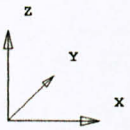
ISOMETRIC

TBG-B JACKET



3D - Topside





APPENDIX B.2: SACS Input File

```
LDOPT       NF+Z   1.03     7.85  -85.65    85.65GLOBMN        FLD   MPT
 TBG-B PLATFORM IN-PLACE ANALYSIS
 ********** TBG-B SIA FOR 20 SBO PLATFORMS ************************************
*-------------------------------------------------------------------------------*
* By    : RNZ INTEGRATED (M) SDN. BHD.                                          *
* For   : PETRONAS CARIGALI SDN. BHD. (SBO)                                     *
* Date  : JUNE 2008                                                             *
* Fn    : SACINP.TBG-B & PSIINP.TBG-B                                           *
*-------------------------------------------------------------------------------*
*                                                                               *
*   MODEL CHANGES OF STRUCTURAL INTEGRITY ANALYSIS FOR 20 PLATFORMS             *
*   ARE AS PER STRUCTURAL MODEL REPORT; DOC. NO. P5178-ST-RP-019A               *
*                                                                               *
*********************************************************************************
*                                                                               *
*    -----------                                                                *
*       1    -   COMPUTER GENERATED STRUCTURAL WEIGHT                          *
*      2A    -   JACKET APPURTENANCES DEAD LOAD                                *
*      2B    -   DECK APPURTENANCES DEAD LOAD                                  *
*       3    -   EQUIPMENT OPERATING WEIGHT                                    *
*       4    -   PIPING OPERATING WEIGHT                                       *
*       5    -   JIB CRANE DEAD LOAD                                           *
*      6A    -   JACKET WALKWAY LIVE LOAD                                      *
*      6B    -   TOPSIDE OPEN AREA LIVE LOAD                                   *
*       7    -   OPERATING WIND ON DECK IN X DIRECTION                         *
*       8    -   OPERATING WIND ON DECK IN Y DIRECTION                         *
*     301    -   MOORING LOAD -   0.00 DEG                                     *
*     302    -   MOORING LOAD - 318.63 DEG                                     *
*     303    -   MOORING LOAD - 270.00 DEG                                     *
*     101    -   OPERATING WAVE/CURRENT    -   0.00 DEGREES                   *
*     102    -   OPERATING WAVE/CURRENT    -  41.37 DEGREES                   *
*     103    -   OPERATING WAVE/CURRENT    -  90.00 DEGREES                   *
*     104    -   OPERATING WAVE/CURRENT    - 138.63 DEGREES                   *
*     105    -   OPERATING WAVE/CURRENT    - 180.00 DEGREES                   *
*     106    -   OPERATING WAVE/CURRENT    - 221.37 DEGREES                   *
*     107    -   OPERATING WAVE/CURRENT    - 270.00 DEGREES                   *
*     108    -   OPERATING WAVE/CURRENT    - 318.63 DEGREES                   *
*     111    -   STORM WAVE/CURRENT    -   0.00 DEGREES                       *
*     112    -   STORM WAVE/CURRENT    -  41.37 DEGREES                       *
*     113    -   STORM WAVE/CURRENT    -  90.00 DEGREES                       *
*     114    -   STORM WAVE/CURRENT    - 138.63 DEGREES                       *
*     115    -   STORM WAVE/CURRENT    - 180.00 DEGREES                       *
*     116    -   STORM WAVE/CURRENT    - 221.37 DEGREES                       *
*     117    -   STORM WAVE/CURRENT    - 270.00 DEGREES                       *
*     118    -   STORM WAVE/CURRENT    - 318.63 DEGREES                       *
*     311    -   SOFT MOORING WAVE/CURRENT -   0.00 DEG                       *
*     312    -   SOFT MOORING WAVE/CURRENT - 318.63 DEG                       *
*     313    -   SOFT MOORING WAVE/CURRENT - 270.00 DEG                       *
*     121    -   OPERATING WAVE/CURRENT INERTIAL   -   0.00 DEGREES          *
*     122    -   OPERATING WAVE/CURRENT INERTIAL   -  41.37 DEGREES          *
*     123    -   OPERATING WAVE/CURRENT INERTIAL   -  90.00 DEGREES          *
*     124    -   OPERATING WAVE/CURRENT INERTIAL   - 138.63 DEGREES          *
*     125    -   OPERATING WAVE/CURRENT INERTIAL   - 180.00 DEGREES          *
*     126    -   OPERATING WAVE/CURRENT INERTIAL   - 221.37 DEGREES          *
*     127    -   OPERATING WAVE/CURRENT INERTIAL   - 270.00 DEGREES          *
*     128    -   OPERATING WAVE/CURRENT INERTIAL   - 318.63 DEGREES          *
*     131    -   STORM WAVE/CURRENT INERTIAL   -   0.00 DEGREES              *
*     132    -   STORM WAVE/CURRENT INERTIAL   -  41.37 DEGREES              *
*     133    -   STORM WAVE/CURRENT INERTIAL   -  90.00 DEGREES              *
*     134    -   STORM WAVE/CURRENT INERTIAL   - 138.63 DEGREES              *
*     135    -   STORM WAVE/CURRENT INERTIAL   - 180.00 DEGREES              *
*     136    -   STORM WAVE/CURRENT INERTIAL   - 221.37 DEGREES              *
*     137    -   STORM WAVE/CURRENT INERTIAL   - 270.00 DEGREES              *
*     138    -   STORM WAVE/CURRENT INERTIAL   - 318.63 DEGREES              *
*     321    -   SOFT MOORING WAVE/CURRENT INERTIAL-   0.00 DEG              *
*     322    -   SOFT MOORING WAVE/CURRENT INERTIAL- 318.63 DEG              *
*     323    -   SOFT MOORING WAVE/CURRENT INERTIAL- 270.00 DEG              *
*                                                                             *
*******************************************************************************
 ********** TEMBUNGO-B JACKET INPLACE ANALYSIS (REV: 4)-*********************** *
*                                                                               *
*    NB: This computer file has been re-typed based on Protek inplace report*
*        and the results have been found to agreed closely with the Protek    *
*        inplace results                                                      *
*        The computer model does not include additional conductor framing     *
*        extensions and additional three conductors                           *
*********************************************************************************
*                    MMC OIL & GAS ENGG. SDN. BHD.                              *
*                          PNB BUILDING                                         *
*                          KUALA LUMPUR                                         *
```

```
*                                                                              *
*******************************************************************************
*                                                                              *
*     CLIENT      : PETRONAS CARIGALI SDN. BHD  - PCSB                         *
*                                                                              *
*     DESCRIPTION : STRUCTURAL INTEGRITY ASSESSMENT (FATIGUE)                  *
*                                                                              *
*******************************************************************************
*     REV:1  Model include additional 3 conductors, conductor framings below*
*            MSL and old conductor guard at MSL. Re-analysis was carried-out*
*            in-house by PCSB and found 3 conductors having I.R > 1.00        *
*                                                                             *
*     REV:3  Model include additional/upgrade conductor framing at sea deck *
*            actual riser guard model, and new full face conductor guard     *
*            model.                                                          *
*            Re-analysis was carried-out in-house by PCSB                    *
*            in-house by PCSB.                                               *
*                                                                            *
*     REV:4  Same as rev.3 except some member sizes                          *
*            has been revised to reflect sizes that was shown on as-built   *
*            drawings.(PERFORMED BY MMC)                                     *
*                                                                            *
******************************************************************************
*    BASIC LOADS                                                             *
*    -----------                                                             *
*       1   -   DECK SELFWEIGHT                                              *
*       2   -   EQUIPMENT LOAD                                               *
*       3   -   CRANE LOAD                                                   *
*       4   -   JACKET GENERATED SELFWEIGHT                                  *
*       5   -   JACKET APPURTENANCES                                         *
*       6   -   STORM WIND ON DECK    -   0 DEGREES                          *
*       7   -   STORM WIND ON DECK    -  48 DEGREES                          *
*       8   -   STORM WIND ON DECK    -  90 DEGREES                          *
*       9   -   STORM WIND ON DECK    - 132 DEGREES                          *
*      10   -   STORM WIND ON DECK    - 180 DEGREES                          *
*      11   -   STORM WIND ON DECK    - 228 DEGREES                          *
*      12   -   STORM WIND ON DECK    - 270 DEGREES                          *
*      13   -   STORM WIND ON DECK    - 312 DEGREES                          *
*      14   -   STORM WAVE/CURRENT    -   0 DEGREES                          *
*      15   -   STORM WAVE/CURRENT    -  48 DEGREES                          *
*      16   -   STORM WAVE/CURRENT    -  90 DEGREES                          *
*      17   -   STORM WAVE/CURRENT    - 132 DEGREES                          *
*      18   -   STORM WAVE/CURRENT    - 180 DEGREES                          *
*      19   -   STORM WAVE/CURRENT    - 228 DEGREES                          *
*      20   -   STORM WAVE/CURRENT    - 270 DEGREES                          *
*      21   -   STORM WAVE/CURRENT    - 312 DEGREES                          *
*      22   -   OPERATING WIND ON DECK    -   0 DEGREES                      *
*      23   -   OPERATING WIND ON DECK    -  48 DEGREES                      *
*      24   -   OPERATING WIND ON DECK    -  90 DEGREES                      *
*      25   -   OPERATING WIND ON DECK    - 132 DEGREES                      *
*      26   -   OPERATING WIND ON DECK    - 180 DEGREES                      *
*      27   -   OPERATING WIND ON DECK    - 228 DEGREES                      *
*      28   -   OPERATING WIND ON DECK    - 270 DEGREES                      *
*      29   -   OPERATING WIND ON DECK    - 312 DEGREES                      *
*      30   -   OPERATING WAVE/CURRENT    -   0 DEGREES                      *
*      31   -   OPERATING WAVE/CURRENT    -  48 DEGREES                      *
*      32   -   OPERATING WAVE/CURRENT    -  90 DEGREES                      *
*      33   -   OPERATING WAVE/CURRENT    - 132 DEGREES                      *
*      34   -   OPERATING WAVE/CURRENT    - 180 DEGREES                      *
*      35   -   OPERATING WAVE/CURRENT    - 228 DEGREES                      *
*      36   -   OPERATING WAVE/CURRENT    - 270 DEGREES                      *
*      37   -   OPERATING WAVE/CURRENT    - 312 DEGREES                      *
*      38   -   MOORING LOAD IN +X DIRECTION                                 *
*      39   -   MOORING LOAD IN -Y DIRECTION                                 *
*******************************************************************************
OPTIONS      MN    PI  SDUCJT 4 4   DC  C    PTPTPT  PT    PT
LCSEL ST        CS01 OP01 OP02 OP03 OP04 OP05 OP06 OP07 OP08 ST01 ST02 ST03
LCSEL ST        ST04 ST05 ST06 ST07 ST08 SX01 SX02 SX03 SX04 SX05 SX06 SX07
LCSEL ST        SX08
**LCSEL ST        SM11 SM12 SM13 SM21 SM22 SM23 SM31 SM32 SM33 SM41 SM42 SM43
**LCSEL ST        SM51 SM52 SM53 SM61 SM62 SM63
HYDRO +ZAPEXTMNNO       85.65    -85.65                1.02
HYDRO2     0.9 ML 0.8  2.0
UCPART    1.0       .8   1.0   0.00.8
AMOD
AMOD   ST01 1.33 ST02 1.33 ST03 1.33 ST04 1.33 ST05 1.33 ST06 1.33 ST07 1.33
AMOD   ST08 1.33 SX01 1.33 SX02 1.33 SX03 1.33 SX04 1.33 SX05 1.33 SX06 1.33
AMOD   SX07 1.33 SX08 1.33
SECT
```

```
SECT BEM      BOX158.3811400.0 21440.0  5235.0   31.1 1.0   16.8 2.5
SECT CLL      BOX415.5982770.0 239000.041860.0   63.5 1.0   31.1 3.14
SECT COL      BOX643.12184500.0366000.093190.0   62.8 1.8   35.8 5.0
SECT CONE     CON                               137.2 2.54 121.9
SECT GR1      TUB                               153.0 4.1  137.2 3.8
SECT GR2      TUB                               148.0 1.6  137.2 3.8
SECT GR3      TUB                               151.8 3.5  137.2 3.8
SECT GR4      TUB                               150.5 2.9  137.2 3.8
SECT WFC      BOX929.1 574300.01067000.222800.0  93.3 2.54  42.3 4.4
SECT WFF      BOX627.71252700.0585100.080930.0   91.062.0   30.422.39
SECT WFW      WF 448.05 1139.0 518000.023750.0   31.143.14  93.5 1.84
```

```
*********************************************************************************
*                                  CALM SEA                                     *
*********************************************************************************
LCOMB
LCOMB CS01     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB CS01     6A1.0      6B1.0
*********************************************************************************
*                    OPERATING WITH MAXIMUM TOPSIDE LOAD                        *
*********************************************************************************
LCOMB OP01     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB OP01     6A1.0      6B1.0       71.0     1011.05    121.086
LCOMB OP02     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB OP02     6A1.0      6B1.0       70.5       80.5     1021.05    122.086
LCOMB OP03     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB OP03     6A1.0      6B1.0       81.0     1031.05    123.086
LCOMB OP04     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB OP04     6A1.0      6B1.0      7-0.5       80.5     1041.05    124.086
LCOMB OP05     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB OP05     6A1.0      6B1.0      7-1.0     1051.05    125.086
LCOMB OP06     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB OP06     6A1.0      6B1.0      7-0.5       8-0.5     1061.05    126.086
LCOMB OP07     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB OP07     6A1.0      6B1.0      8-1.0     1071.05    127.086
LCOMB OP08     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB OP08     6A1.0      6B1.0       7.5       8-0.5     1081.05    128.086
*********************************************************************************
*                                 SOFT MOORING                                  *
*********************************************************************************
LCOMB SM11     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM11     6A1.0      6B1.0       71.0     3011.0     3111.05    321.044
LCOMB SM12     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM12     6A1.0      6B1.0       7.5        8-.5      3021.0     3121.05
LCOMB SM12    322.044
LCOMB SM13     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM13     6A1.0      6B1.0      8-1.0     3031.0     3131.05    323.044
LCOMB SM21     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM21     6A1.0      6B1.0       71.0     3012.0     3111.05    321.044
LCOMB SM22     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM22     6A1.0      6B1.0       7.5        8-.5      3022.0     3121.05
LCOMB SM22    322.044
LCOMB SM23     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM23     6A1.0      6B1.0      8-1.0     3032.0     3131.05    323.044
LCOMB SM31     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM31     6A1.0      6B1.0       71.0     3013.0     3111.05    321.044
LCOMB SM32     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM32     6A1.0      6B1.0       7.5        8-.5      3023.0     3121.05
LCOMB SM32    322.044
LCOMB SM33     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM33     6A1.0      6B1.0      8-1.0     3033.0     3131.05    323.044
LCOMB SM41     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM41     6A1.0      6B1.0       71.0     3014.0     3111.05    321.044
LCOMB SM42     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM42     6A1.0      6B1.0       7.5        8-.5      3024.0     3121.05
LCOMB SM42    322.044
LCOMB SM43     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM43     6A1.0      6B1.0      8-1.0     3034.0     3131.05    323.044
LCOMB SM51     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM51     6A1.0      6B1.0       71.0     3015.0     3111.05    321.044
LCOMB SM52     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM52     6A1.0      6B1.0       7.5        8-.5      3025.0     3121.05
LCOMB SM52    322.044
LCOMB SM53     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM53     6A1.0      6B1.0      8-1.0     3035.0     3131.05    323.044
LCOMB SM61     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM61     6A1.0      6B1.0       71.0     3016.0     3111.05    321.044
LCOMB SM62     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM62     6A1.0      6B1.0       7.5        8-.5      3026.0     3121.05
LCOMB SM62    322.044
LCOMB SM63     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB SM63     6A1.0      6B1.0      8-1.0     3036.0     3131.05    323.044
*********************************************************************************
*                    STORM WITH MAXIMUM TOPSIDE LOAD                            *
*********************************************************************************
LCOMB ST01     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB ST01     6A1.0      6B1.0       74.0     1111.05    131.062
LCOMB ST02     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB ST02     6A1.0      6B1.0       72.0       82.0     1121.05    132.115
LCOMB ST03     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB ST03     6A1.0      6B1.0       84.0     1131.05    133.115
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LCOMB ST04     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB ST04    6A1.0      6B1.0       7-2.0      82.0     1141.05    134.115
LCOMB ST05     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB ST05    6A1.0      6B1.0       7-4.0     1151.05    135.062
LCOMB ST06     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB ST06    6A1.0      6B1.0       7-2.0      8-2.0     1161.05    136.055
LCOMB ST07     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB ST07    6A1.0      6B1.0       8-4.0     1171.05    137.055
LCOMB ST08     11.05     2A1.05     2B1.05      31.05      41.05      51.05
LCOMB ST08    6A1.0      6B1.0       72.0       8-2.0     1181.05    138.055
*********************************************************************************
*                      STORM WITH MINIMUM TOPSIDE LOAD                          *
*********************************************************************************
LCOMB SX01     11.0      2A1.0      2B1.0       31.0       41.0       51.0
LCOMB SX01     74.0     1111.05    131.062
LCOMB SX02     11.0      2A1.0      2B1.0       31.0       41.0       51.0
LCOMB SX02     72.0       82.0     1121.05    132.115
LCOMB SX03     11.0      2A1.0      2B1.0       31.0       41.0       51.0
LCOMB SX03     84.0     1131.05    133.115
LCOMB SX04     11.0      2A1.0      2B1.0       31.0       41.0       51.0
LCOMB SX04     7-2.0      82.0     1141.05    134.115
LCOMB SX05     11.0      2A1.0      2B1.0       31.0       41.0       51.0
LCOMB SX05     7-4.0    1151.05    135.062
LCOMB SX06     11.0      2A1.0      2B1.0       31.0       41.0       51.0
LCOMB SX06     7-2.0      8-2.0     1161.05    136.055
LCOMB SX07     11.0      2A1.0      2B1.0       31.0       41.0       51.0
LCOMB SX07     8-4.0    1171.05    137.055
LCOMB SX08     11.0      2A1.0      2B1.0       31.0       41.0       51.0
LCOMB SX08     72.0       8-2.0     1181.05    138.055
LOADLBCS01 CALM SEA
LOADLBOP01 1 YEAR OPERATING WITH MAXIMUM TOPSIDE (0.00°)
LOADLBOP02 1 YEAR OPERATING WITH MAXIMUM TOPSIDE (41.37°)
LOADLBOP03 1 YEAR OPERATING WITH MAXIMUM TOPSIDE (90.00°)
LOADLBOP04 1 YEAR OPERATING WITH MAXIMUM TOPSIDE (138.63°)
LOADLBOP05 1 YEAR OPERATING WITH MAXIMUM TOPSIDE (180°)
LOADLBOP06 1 YEAR OPERATING WITH MAXIMUM TOPSIDE (221.37°)
LOADLBOP07 1 YEAR OPERATING WITH MAXIMUM TOPSIDE (270°)
LOADLBOP08 1 YEAR OPERATING WITH MAXIMUM TOPSIDE (318.63°)
LOADLBSM11 SOFT MOORING AT 0.00 DEGREE WITH  2 x 10 ST
LOADLBSM12 SOFT MOORING AT 318.63 DEGREE WITH 2 X 10 ST
LOADLBSM13 SOFT MOORING AT 270 DEGREE WITH 2 x 10 ST
LOADLBSM21 SOFT MOORING AT 0.00 DEGREE WITH 2 x 20 ST
LOADLBSM22 SOFT MOORING AT 318.63 DEGREE WITH 2 x 20 ST
LOADLBSM23 SOFT MOORING AT 270 DEGREE WITH 2 x 20 ST
LOADLBSM31 SOFT MOORING AT 0.00 DEGREE WITH 2 x 30 ST
LOADLBSM32 SOFT MOORING AT 318.63 DEGREE WITH 2 x 30 ST
LOADLBSM33 SOFT MOORING AT 270 DEGREE WITH 2 x 30 ST
LOADLBSM41 SOFT MOORING AT 0.00 DEGREE WITH 2 x 40 ST
LOADLBSM42 SOFT MOORING AT 318.63 DEGREE WITH 2 x 40 ST
LOADLBSM43 SOFT MOORING AT 270 DEGREE WITH 2 x 40 ST
LOADLBSM51 SOFT MOORING AT 0.00 DEGREE WITH 2 x 50 ST
LOADLBSM52 SOFT MOORING AT 318.63 DEGREE WITH 2 x 50 ST
LOADLBSM53 SOFT MOORING AT 270 DEGREE WITH 2 x 50 ST
LOADLBSM61 SOFT MOORING AT 0.00 DEGREE WITH 2 x 60 ST
LOADLBSM62 SOFT MOORING AT 318.63 DEGREE WITH 2 x 60 ST
LOADLBSM63 SOFT MOORING AT 270 DEGREE WITH 2 x 60 ST
LOADLBST01 100 YEAR STORM WITH MAXIMUM TOPSIDE (0.00°)
LOADLBST02 100 YEAR STORM WITH MAXIMUM TOPSIDE (41.37°)
LOADLBST03 100 YEAR STORM WITH MAXIMUM TOPSIDE (90.00°)
LOADLBST04 100 YEAR STORM WITH MAXIMUM TOPSIDE (138.63°)
LOADLBST05 100 YEAR STORM WITH MAXIMUM TOPSIDE (180°)
LOADLBST06 100 YEAR STORM WITH MAXIMUM TOPSIDE (221.37°)
LOADLBST07 100 YEAR STORM WITH MAXIMUM TOPSIDE (270°)
LOADLBST08 100 YEAR STORM WITH MAXIMUM TOPSIDE (318.63°)
LOADLBSX01 100 YEAR STORM WITH MINIMUM TOPSIDE (0.00°)
LOADLBSX02 100 YEAR STORM WITH MINIMUM TOPSIDE (41.37°)
LOADLBSX03 100 YEAR STORM WITH MINIMUM TOPSIDE (90.00°)
LOADLBSX04 100 YEAR STORM WITH MINIMUM TOPSIDE (138.63°)
LOADLBSX05 100 YEAR STORM WITH MINIMUM TOPSIDE (180°)
LOADLBSX06 100 YEAR STORM WITH MINIMUM TOPSIDE (221.37°)
LOADLBSX07 100 YEAR STORM WITH MINIMUM TOPSIDE (270°)
LOADLBSX08 100 YEAR STORM WITH MINIMUM TOPSIDE (318.63°)
END
```

APPENDIX B.3: SACS Output File

TBG-B PLATFORM IN-PLACE ANALYSIS

** SEASTATE BASIC LOAD CASE DESCRIPTIONS **

LOAD CASE	LOAD LABEL	********** DESCRIPTION **********
1	1	COMPUTER GENERATED STRUCTURAL WEIGHT
2	3	EQUIPMENT OPERATING WEIGHT
3	4	PIPING OPERATING WEIGHT
4	5	JIB CRANE DEAD LOAD
5	7	OPERATING WIND IN X DIRECTION
6	8	OPERATING WIND IN Y DIRECTION
7	2A	JACKET APPURTENANCES DEAD LOAD
8	2B	DECK APPURTENANCES DEAD LOAD
9	6A	JACKET WALKWAY LIVE LOAD
10	6B	TOPSIDE OPEN AREA LIVE LOAD
11	101	OPERATING WAVE/CURRENT - 0.00 DEGREES
12	102	OPERATING WAVE/CURRENT - 41.37 DEGREES
13	103	OPERATING WAVE/CURRENT - 90.00 DEGREES
14	104	OPERATING WAVE/CURRENT - 138.63 DEGREES
15	105	OPERATING WAVE/CURRENT - 180.00 DEGREES
16	106	OPERATING WAVE/CURRENT - 221.37 DEGREES
17	107	OPERATING WAVE/CURRENT - 270.00 DEGREES
18	108	OPERATING WAVE/CURRENT - 318.63 DEGREES
19	111	STORM WAVE/CURRENT - 0.00 DEGREES
20	112	STORM WAVE/CURRENT - 41.37 DEGREES
21	113	STORM WAVE/CURRENT - 90.00 DEGREES
22	114	STORM WAVE/CURRENT - 138.63 DEGREES
23	115	STORM WAVE/CURRENT - 180.00 DEGREES
24	116	STORM WAVE/CURRENT - 221.37 DEGREES
25	117	STORM WAVE/CURRENT - 270.00 DEGREES
26	118	STORM WAVE/CURRENT - 318.63 DEGREES
27	121	OPERATING WAVE/CURRENT INERTIAL - 0.00 DEGREES
28	122	OPERATING WAVE/CURRENT INERTIAL - 41.37 DEGREES
29	123	OPERATING WAVE/CURRENT INERTIAL - 90.00 DEGREES
30	124	OPERATING WAVE/CURRENT INERTIAL - 138.63 DEGREES
31	125	OPERATING WAVE/CURRENT INERTIAL - 180.00 DEGREES
32	126	OPERATING WAVE/CURRENT INERTIAL - 221.37 DEGREES
33	127	OPERATING WAVE/CURRENT INERTIAL - 270.00 DEGREES
34	128	OPERATING WAVE/CURRENT INERTIAL - 318.63 DEGREES
35	131	STORM WAVE/CURRENT - 0.00 DEGREES
36	132	STORM WAVE/CURRENT - 41.37 DEGREES
37	133	STORM WAVE/CURRENT - 90.00 DEGREES
38	134	STORM WAVE/CURRENT - 138.63 DEGREES
39	135	STORM WAVE/CURRENT - 180.00 DEGREES
40	136	STORM WAVE/CURRENT - 221.37 DEGREES
41	137	STORM WAVE/CURRENT - 270.00 DEGREES
42	138	STORM WAVE/CURRENT - 318.63 DEGREES
43	301	MOORING LOADS- 0 DEG
44	302	MOORING LOADS- 318.63
45	303	MOORING LOADS- 270 DEG

TBG-B PLATFORM IN-PLACE ANALYSIS

** SEASTATE BASIC LOAD CASE DESCRIPTIONS **

LOAD CASE	LOAD LABEL	********** DESCRIPTION **********
46	311	SOFT SOFT MOORING WAVE/CURRENT - 0.00 DEG
47	312	SOFT SOFT MOORING WAVE/CURRENT- 318.63 DEG
48	313	SOFT SOFT MOORING WAVE/CURRENT- 270.00 DEG
49	321	SOFT SOFT MOORING WAVE/CURRENT INERTIAL- 0.00 DEG
50	322	SOFT SOFT MOORING WAVE/CURRENT INERTIAL- 318.63 DEG
51	323	SOFT SOFT MOORING WAVE/CURRENT INERTIAL- 270.00 DEG

TBG-B PLATFORM IN-PLACE ANALYSIS

****** SEASTATE BASIC LOAD CASE SUMMARY ******
RELATIVE TO MUDLINE ELEVATION

LOAD CASE	LOAD LABEL	FX (KN)	FY (KN)	FZ (KN)	MX (KN-M)	MY (KN-M)	MZ (KN-M)	DEAD LOAD (KN)	BUOYANCY (KN)
1	1	0.000	0.002	-13293.925	-180.712	100605.484	0.023	22107.453	8813.530
2	3	0.000	0.000	-599.006	282.177	7877.916	0.000	0.000	0.000
3	4	0.000	0.000	-1103.718	-512.076	9378.110	0.000	0.000	0.000
4	5	0.000	0.000	-76.920	536.048	857.042	0.000	0.000	0.000
5	7	24.960	0.000	0.000	0.000	2480.175	-1.903	0.000	0.000
6	8	0.000	19.440	0.000	-1931.675	0.000	150.538	0.000	0.000
7	2A	0.000	0.000	-844.118	-935.904	8529.452	0.000	0.000	0.000
8	2B	0.000	0.000	-1442.284	116.255	9899.691	0.000	0.000	0.000
9	6A	0.000	0.000	-211.488	0.181	2058.873	0.000	0.000	0.000
10	6B	0.000	0.000	-457.515	884.433	4287.450	0.000	0.000	0.000
11	101	3186.973	8.184	1.957	-903.366	226141.703	185.481	0.000	0.000
12	102	2507.110	2265.216	-18.594	-160902.109	177316.688	12790.287	0.000	0.000
13	103	-14.679	3315.673	-46.432	-236600.312	-963.853	18735.551	0.000	0.000
14	104	-2491.697	2202.131	-112.139	-156005.406	-175810.656	12266.088	0.000	0.000
15	105	-3127.698	-10.766	-128.572	1006.545	-221480.969	-62.585	0.000	0.000
16	106	-2482.199	-2208.376	-115.811	156664.891	-174718.797	-12274.224	0.000	0.000
17	107	-2.353	-3310.699	-58.882	235935.266	552.314	-18642.354	0.000	0.000
18	108	2498.591	-2243.912	-21.625	158633.078	176713.094	-12596.924	0.000	0.000
19	111	7291.260	8.842	99.188	-1015.648	503746.562	285.234	0.000	0.000
20	112	1186.613	1082.332	-15.928	-80176.281	87665.250	6107.667	0.000	0.000
21	113	-15.475	1327.804	-15.651	-101028.688	-1219.270	7277.899	0.000	0.000
22	114	-1215.970	1067.564	-61.212	-78330.805	-89026.742	5723.075	0.000	0.000
23	115	-3961.815	-11.328	-138.850	1122.366	-293152.375	-357.592	0.000	0.000
24	116	-3252.291	-2908.816	-118.377	220557.188	-244534.094	-16197.599	0.000	0.000
25	117	-16.265	-4324.849	15.776	328957.562	-646.019	-23749.420	0.000	0.000
26	118	3992.798	-3603.124	-7.859	265015.625	293807.000	-19702.488	0.000	0.000
27	121	3186.973	8.184	1.957	-903.366	226141.703	185.481	0.000	0.000
28	122	2507.110	2265.216	-18.594	-160902.109	177316.688	12790.287	0.000	0.000
29	123	-14.679	3315.673	-46.432	-236600.312	-963.853	18735.551	0.000	0.000
30	124	-2491.697	2202.131	-112.139	-156005.406	-175810.656	12266.088	0.000	0.000
31	125	-3127.698	-10.766	-128.572	1006.545	-221480.969	-62.585	0.000	0.000
32	126	-2482.199	-2208.376	-115.811	156664.891	-174718.797	-12274.224	0.000	0.000
33	127	-2.353	-3310.699	-58.882	235935.266	552.314	-18642.354	0.000	0.000
34	128	2498.591	-2243.912	-21.625	158633.078	176713.094	-12596.924	0.000	0.000
35	131	7291.260	8.842	99.188	-1015.648	503746.562	285.234	0.000	0.000
36	132	1186.613	1082.332	-15.928	-80176.281	87665.250	6107.667	0.000	0.000
37	133	-15.475	1327.804	-15.651	-101028.688	-1219.270	7277.899	0.000	0.000
38	134	-1215.970	1067.564	-61.212	-78330.805	-89026.742	5723.075	0.000	0.000
39	135	-3961.815	-11.328	-138.850	1122.366	-293152.375	-357.592	0.000	0.000
40	136	-3252.291	-2908.816	-118.377	220557.188	-244534.094	-16197.599	0.000	0.000
41	137	-16.265	-4324.849	15.776	328957.562	-646.019	-23749.420	0.000	0.000
42	138	3992.798	-3603.124	-7.859	265015.625	293807.000	-19702.488	0.000	0.000
43	301	178.000	0.000	0.000	0.000	16059.511	981.136	0.000	0.000
44	302	125.860	-125.860	0.000	11355.338	11355.338	-182.812	0.000	0.000
45	303	0.000	-178.000	0.000	16059.511	0.000	-1239.681	0.000	0.000

TBG-B PLATFORM IN-PLACE ANALYSIS

****** SEASTATE BASIC LOAD CASE SUMMARY ******
RELATIVE TO MUDLINE ELEVATION

LOAD CASE	LOAD LABEL	FX (KN)	FY (KN)	FZ (KN)	MX (KN-M)	MY (KN-M)	MZ (KN-M)	DEAD LOAD (KN)	BUOYANCY (KN)
46	311	1858.682	1.417	20.013	-149.510	115099.328	-198.045	0.000	0.000
47	312	1427.600	-1268.270	14.518	77703.867	87187.617	-8197.022	0.000	0.000
48	313	-5.100	-1896.756	-14.629	118136.055	-235.576	-11506.749	0.000	0.000
49	321	1858.682	1.417	20.013	-149.510	115099.328	-198.045	0.000	0.000
50	322	1427.600	-1268.270	14.518	77703.867	87187.617	-8197.022	0.000	0.000
51	323	-5.100	-1896.756	-14.629	118136.055	-235.576	-11506.749	0.000	0.000

TBG-B PLATFORM IN-PLACE ANALYSIS

***** SEASTATE COMBINED LOAD CASE SUMMARY *****
RELATIVE TO MUDLINE ELEVATION

LOAD CASE	LOAD LABEL	FX (KN)	FY (KN)	FZ (KN)	MX (KN-M)	MY (KN-M)	MZ (KN-M)
52	CS01	0.000	0.002	-18896.973	155.692	150351.391	0.024
53	OP01	3645.361	9.299	-18894.750	-870.532	409728.531	208.827
54	OP02	2860.557	2583.007	-18918.096	-183594.922	353023.250	14604.107
55	OP03	-16.676	3786.046	-18949.719	-270553.938	149256.453	21434.146
56	OP04	-2843.047	2511.343	-19024.363	-178032.281	-50609.598	14010.520
57	OP05	-3578.026	-12.228	-19043.029	1299.128	-103731.148	-69.169
58	OP06	-2832.259	-2518.433	-19028.533	179092.844	-49369.242	-14017.811
59	OP07	-2.673	-3780.392	-18963.863	270109.812	150978.812	-21328.227
60	OP08	2850.879	-2558.802	-18921.539	181328.703	352337.531	-14386.302
61	SM11	2236.358	1.552	-18875.078	-7.872	294809.750	762.595
62	SM12	1700.134	-1523.066	-18881.090	97484.891	258330.062	-9226.551
63	SM13	-5.579	-2272.489	-18912.979	147387.703	150093.672	-13978.577
64	SM21	2414.358	1.552	-18875.078	-7.872	310869.250	1743.731
65	SM22	1825.994	-1648.926	-18881.090	108840.227	269685.406	-9409.362
66	SM23	-5.579	-2450.489	-18912.979	163447.219	150093.672	-15218.258
67	SM31	2592.358	1.552	-18875.078	-7.872	326928.750	2724.867
68	SM32	1951.854	-1774.785	-18881.090	120195.562	281040.750	-9592.174
69	SM33	-5.579	-2628.489	-18912.979	179506.734	150093.672	-16457.939
70	SM41	2770.358	1.552	-18875.078	-7.872	342988.281	3706.002
71	SM42	2077.714	-1900.645	-18881.090	131550.906	292396.094	-9774.985
72	SM43	-5.579	-2806.489	-18912.979	195566.234	150093.672	-17697.619
73	SM51	2948.358	1.552	-18875.078	-7.872	359047.781	4687.138
74	SM52	2203.574	-2026.505	-18881.090	142906.234	303751.406	-9957.797
75	SM53	-5.579	-2984.488	-18912.979	211625.750	150093.672	-18937.299
76	SM61	3126.358	1.552	-18875.078	-7.872	375107.281	5668.273
77	SM62	2329.434	-2152.365	-18881.090	154261.578	315106.750	-10140.608
78	SM63	-5.579	-3162.488	-18912.979	227685.266	150093.672	-20176.980
79	ST01	8207.721	9.834	-18786.674	-973.708	720438.250	309.591
80	ST02	1432.323	1299.798	-18915.529	-97113.023	257441.734	7412.726
81	ST03	-18.029	1624.653	-18915.207	-125269.414	148930.938	9080.929
82	ST04	-1466.525	1282.594	-18968.283	-94963.031	41674.898	6972.289
83	ST05	-4505.378	-12.595	-19051.375	1403.763	-185554.734	-390.006
84	ST06	-3643.701	-3253.119	-19027.777	247734.719	-124819.109	-18195.592
85	ST07	-17.973	-4856.715	-18879.541	371380.469	149637.547	-26845.238
86	ST08	4461.961	-4020.330	-18905.656	296861.312	479968.438	-22076.107
87	SX01	8207.721	9.834	-17249.672	-1823.613	707234.562	309.590
88	SX02	1432.323	1299.798	-17378.527	-97962.922	244238.047	7412.725
89	SX03	-18.029	1624.653	-17378.205	-126119.320	135727.250	9080.928
90	SX04	-1466.525	1282.594	-17431.281	-95812.938	28471.209	6972.288
91	SX05	-4505.378	-12.595	-17514.373	553.859	-198758.422	-390.007
92	SX06	-3643.701	-3253.119	-17490.775	246884.812	-138022.797	-18195.592
93	SX07	-17.973	-4856.716	-17342.539	370530.562	136433.859	-26845.238
94	SX08	4461.961	-4020.330	-17368.654	296011.375	466764.750	-22076.107

TBG-B PLATFORM IN-PLACE ANALYSIS

********** SEASTATE LOAD CASE CENTER REPORT **********
RELATIVE TO STRUCTURAL ORIGIN

LOAD CASE	LOAD LABEL	********* X - DIRECTION ********* FORCE (KN)	X (M)	Y (M)	Z (M)	********* Y - DIRECTION ********* FORCE (KN)	X (M)	Y (M)	Z (M)	********* Z - DIRECTION ********* FORCE (KN)	X (M)	Y (M)	Z (M)
1	1	COUPLE	0.04	0.00	-0.30	COUPLE	0.04	0.00	-0.32	-13293.92	7.02	0.01	-16.10
2	3	0.00				0.00				-599.01	13.15	-0.47	12.34
3	4	0.00				0.00				-1103.72	8.50	0.46	14.03
4	5	0.00				0.00				-76.92	11.14	-6.97	16.76
5	7	24.96	7.74	0.08	13.72	0.00				0.00			
6	8	0.00				19.44	7.74	0.08	13.72	0.00			
7	2A	0.00				0.00				-844.12	10.10	1.11	-20.54
8	2B	0.00				0.00				-1442.28	6.86	-0.08	13.23
9	6A	0.00				0.00				-211.49	9.74	0.00	4.57
10	6B	0.00				0.00				-457.52	9.37	-1.93	13.62
11	101	3186.97	5.15	-0.03	-14.07	COUPLE	0.02	0.00	-0.05	COUPLE	0.03	0.00	-0.06
12	102	2507.11	5.37	0.01	-14.31	2265.22	5.66	0.03	-13.94	COUPLE	0.03	0.00	-0.06
13	103	COUPLE	0.03	0.00	-0.05	3315.67	5.64	0.12	-13.54	-46.43	3.24	-41.46	-12.34
14	104	-2491.70	5.20	0.17	-14.22	2202.13	5.38	0.28	-14.07	-112.14	15.62	-11.18	-15.07
15	105	-3127.70	5.06	0.01	-13.93	COUPLE	0.03	0.00	-0.05	-128.57	18.13	-0.28	-15.79
16	106	-2482.20	5.19	-0.16	-14.30	-2208.38	5.38	0.00	-14.01	-115.81	16.97	10.23	-16.32
17	107	COUPLE	0.03	0.00	-0.05	-3310.70	5.62	0.23	-13.61	-58.88	8.63	33.94	-14.12
18	108	2498.59	5.35	-0.02	-14.40	-2243.91	5.63	0.21	-14.16	COUPLE	0.03	0.00	-0.06
19	111	7291.26	5.46	-0.02	-15.98	COUPLE	0.02	0.00	-0.06	99.19	33.44	-1.34	-20.85
20	112	1186.61	5.26	-0.04	-10.90	1082.33	5.60	-0.02	-10.59	COUPLE	0.03	0.01	-0.04
21	113	-15.48	11.09	-1.47	-5.91	1327.80	5.50	0.07	-8.33	-15.65	0.82	-85.23	-26.90
22	114	-1215.97	4.93	0.25	-11.29	1067.56	5.08	0.37	-11.23	-61.21	18.75	-14.74	-15.13
23	115	-3961.82	5.02	-0.08	-10.73	COUPLE	0.03	0.00	-0.05	-138.85	21.88	-0.36	-23.01
24	116	-3252.29	5.11	-0.29	-9.46	-2908.82	5.24	-0.18	-9.08	-118.38	23.07	14.33	-29.34
25	117	COUPLE	0.03	0.00	-0.04	-4324.85	5.50	-0.01	-8.77	COUPLE	0.03	0.00	-0.04
26	118	3992.80	5.45	-0.20	-11.51	-3603.12	5.68	-0.02	-11.34	COUPLE	0.03	0.00	-0.06
27	121	3186.97	5.15	-0.03	-14.07	COUPLE	0.02	0.00	-0.05	COUPLE	0.03	0.00	-0.06
28	122	2507.11	5.37	0.01	-14.31	2265.22	5.66	0.03	-13.94	COUPLE	0.03	0.00	-0.06
29	123	COUPLE	0.03	0.00	-0.05	3315.67	5.64	0.12	-13.54	-46.43	3.24	-41.46	-12.34
30	124	-2491.70	5.20	0.17	-14.22	2202.13	5.38	0.28	-14.07	-112.14	15.62	-11.18	-15.07
31	125	-3127.70	5.06	0.01	-13.93	COUPLE	0.03	0.00	-0.05	-128.57	18.13	-0.28	-15.79
32	126	-2482.20	5.19	-0.16	-14.30	-2208.38	5.38	0.00	-14.01	-115.81	16.97	10.23	-16.32
33	127	COUPLE	0.03	0.00	-0.05	-3310.70	5.62	0.23	-13.61	-58.88	8.63	33.94	-14.12
34	128	2498.59	5.35	-0.02	-14.40	-2243.91	5.63	0.21	-14.16	COUPLE	0.03	0.00	-0.06
35	131	7291.26	5.46	-0.02	-15.98	COUPLE	0.02	0.00	-0.06	99.19	33.44	-1.34	-20.85
36	132	1186.61	5.26	-0.04	-10.90	1082.33	5.60	-0.02	-10.59	COUPLE	0.03	0.01	-0.04
37	133	-15.48	11.09	-1.47	-5.91	1327.80	5.50	0.07	-8.33	-15.65	0.82	-85.23	-26.90
38	134	-1215.97	4.93	0.25	-11.29	1067.56	5.08	0.37	-11.23	-61.21	18.75	-14.74	-15.13
39	135	-3961.82	5.02	-0.08	-10.73	COUPLE	0.03	0.00	-0.05	-138.85	21.88	-0.36	-23.01
40	136	-3252.29	5.11	-0.29	-9.46	-2908.82	5.24	-0.18	-9.08	-118.38	23.07	14.33	-29.34
41	137	COUPLE	0.03	0.00	-0.04	-4324.85	5.50	-0.01	-8.77	COUPLE	0.03	0.00	-0.04
42	138	3992.80	5.45	-0.20	-11.51	-3603.12	5.68	-0.02	-11.34	COUPLE	0.03	0.00	-0.06
43	301	178.00	6.96	-5.51	4.57	0.00				0.00			
44	302	125.86	6.96	-5.51	4.57	-125.86	6.96	-5.51	4.57	0.00			
45	303	0.00				-178.00	6.96	-5.51	4.57	0.00			

TBG-B PLATFORM IN-PLACE ANALYSIS

********** SEASTATE LOAD CASE CENTER REPORT **********
RELATIVE TO STRUCTURAL ORIGIN

LOAD CASE	LOAD LABEL	X - DIRECTION FORCE (KN)	X (M)	Y (M)	Z (M)	Y - DIRECTION FORCE (KN)	X (M)	Y (M)	Z (M)	Z - DIRECTION FORCE (KN)	X (M)	Y (M)	Z (M)
46	311	1858.68	5.76	0.12	-23.28	COUPLE	0.03	0.00	-0.10	20.01	32.25	-0.51	-35.78
47	312	1427.60	6.11	0.12	-24.15	-1268.27	6.33	0.29	-23.92	COUPLE	0.04	0.00	-0.12
48	313	COUPLE	0.04	0.00	-0.10	-1896.76	6.04	0.24	-22.89	COUPLE	0.03	0.00	-0.11
49	321	1858.68	5.76	0.12	-23.28	COUPLE	0.03	0.00	-0.10	20.01	32.25	-0.51	-35.78
50	322	1427.60	6.11	0.12	-24.15	-1268.27	6.33	0.29	-23.92	COUPLE	0.04	0.00	-0.12
51	323	COUPLE	0.04	0.00	-0.10	-1896.76	6.04	0.24	-22.89	COUPLE	0.03	0.00	-0.11
52	CS01	COUPLE	0.04	0.00	-0.30	COUPLE	0.04	0.00	-0.32	-18896.97	7.55	-0.01	-10.07
53	OP01	3645.36	-20.31	0.00	-11.79	COUPLE	0.04	0.00	-0.32	-18894.75	7.47	0.00	-10.03
54	OP02	2860.56	-27.09	0.04	-11.53	2583.01	5.70	-36.36	-13.84	-18918.10	7.48	-0.08	-10.04
55	OP03	COUPLE	0.04	0.00	-0.30	3786.05	5.67	-24.71	-13.41	-18949.72	7.54	-0.12	-10.08
56	OP04	-2843.05	37.88	0.14	-16.77	2511.34	5.42	-37.15	-13.97	-19024.36	7.61	-0.08	-10.10
57	OP05	-3578.03	31.03	-0.02	-15.86	COUPLE	0.04	0.00	-0.32	-19043.03	7.64	-0.01	-10.11
58	OP06	-2832.26	37.99	-0.19	-16.86	-2518.43	5.35	37.33	-13.89	-19028.53	7.62	0.06	-10.11
59	OP07	COUPLE	0.04	0.00	-0.30	-3780.39	5.61	25.10	-13.47	-18963.86	7.56	0.11	-10.08
60	OP08	2850.88	-27.21	0.01	-11.61	-2558.80	5.61	36.95	-14.05	-18921.54	7.49	0.08	-10.05
61	SM11	2236.36	-35.65	-0.29	-17.26	COUPLE	0.04	0.00	-0.32	-18875.08	7.53	-0.01	-10.04
62	SM12	1700.13	-48.44	-0.25	-17.27	-1523.07	6.34	61.54	-21.31	-18881.09	7.53	0.02	-10.05
63	SM13	COUPLE	0.04	0.00	-0.30	-2272.49	6.09	41.16	-20.42	-18912.98	7.55	0.04	-10.08
64	SM21	2414.36	-32.51	-0.68	-15.65	COUPLE	0.04	0.00	-0.32	-18875.08	7.53	-0.01	-10.04
65	SM22	1825.99	-44.62	-0.61	-15.77	-1648.93	6.38	56.42	-19.34	-18881.09	7.53	0.02	-10.05
66	SM23	COUPLE	0.04	0.00	-0.30	-2450.49	6.16	37.77	-18.60	-18912.98	7.55	0.04	-10.08
67	SM31	2592.36	-29.80	-1.01	-14.26	COUPLE	0.04	0.00	-0.32	-18875.08	7.53	-0.01	-10.04
68	SM32	1951.85	-41.29	-0.93	-14.46	-1774.79	6.43	52.03	-17.64	-18881.09	7.53	0.02	-10.05
69	SM33	COUPLE	0.04	0.00	-0.30	-2628.49	6.21	34.84	-17.03	-18912.98	7.55	0.04	-10.08
70	SM41	2770.36	-27.43	-1.30	-13.05	COUPLE	0.04	0.00	-0.32	-18875.08	7.53	-0.01	-10.04
71	SM42	2077.71	-38.37	-1.21	-13.30	-1900.65	6.46	48.22	-16.17	-18881.09	7.53	0.02	-10.05
72	SM43	COUPLE	0.04	0.00	-0.30	-2806.49	6.26	32.28	-15.66	-18912.98	7.55	0.04	-10.08
73	SM51	2948.36	-25.36	-1.55	-11.99	COUPLE	0.04	0.00	-0.32	-18875.08	7.53	-0.01	-10.04
74	SM52	2203.57	-35.78	-1.45	-12.28	-2026.51	6.49	44.88	-14.88	-18881.09	7.53	0.02	-10.05
75	SM53	COUPLE	0.04	0.00	-0.30	-2984.49	6.30	30.02	-14.46	-18912.98	7.55	0.04	-10.08
76	SM61	3126.36	-23.52	-1.78	-11.04	COUPLE	0.04	0.00	-0.32	-18875.08	7.53	-0.01	-10.04
77	SM62	2329.43	-33.47	-1.67	-11.37	-2152.37	6.52	41.93	-13.75	-18881.09	7.53	0.02	-10.05
78	SM63	COUPLE	0.04	0.00	-0.30	-3162.49	6.34	28.02	-13.39	-18912.98	7.55	0.04	-10.08
79	ST01	8207.72	-5.83	-0.01	-14.70	COUPLE	0.04	0.00	-0.32	-18786.67	7.40	0.00	-10.01
80	ST02	1432.32	-59.49	0.03	-4.74	1299.80	5.73	-72.35	-9.87	-18915.53	7.50	-0.06	-10.06
81	ST03	COUPLE	0.04	0.00	-0.30	1624.65	5.66	-57.80	-7.28	-18915.21	7.55	-0.09	-10.09
82	ST04	-1466.53	68.35	0.18	-15.62	1282.59	5.22	-72.94	-10.49	-18968.28	7.60	-0.06	-10.09
83	ST05	-4505.38	25.69	-0.09	-11.87	COUPLE	0.04	0.00	-0.32	-19051.38	7.67	-0.01	-10.17
84	ST06	-3643.70	30.63	-0.31	-11.22	-3253.12	5.24	28.72	-8.81	-19027.78	7.66	0.09	-10.20
85	ST07	COUPLE	0.04	0.00	-0.30	-4856.72	5.51	19.35	-8.41	-18879.54	7.57	0.16	-10.19
86	ST08	4461.96	-15.34	-0.17	-9.53	-4020.33	5.68	23.36	-11.09	-18905.66	7.46	0.12	-10.11
87	SX01	8207.72	-5.29	-0.01	-14.74	COUPLE	0.04	0.00	-0.32	-17249.67	7.32	0.05	-10.77
88	SX02	1432.32	-56.40	0.02	-4.99	1299.80	5.73	-68.90	-9.87	-17378.53	7.42	-0.02	-10.82
89	SX03	COUPLE	0.04	0.00	-0.30	1624.65	5.65	-55.04	-7.28	-17378.21	7.48	-0.05	-10.85
90	SX04	-1466.53	65.33	0.19	-15.37	1282.59	5.22	-69.45	-10.49	-17431.28	7.53	-0.02	-10.85

TBG-B PLATFORM IN-PLACE ANALYSIS

********** SEASTATE LOAD CASE CENTER REPORT **********
RELATIVE TO STRUCTURAL ORIGIN

LOAD CASE	LOAD LABEL	X - DIRECTION FORCE (KN)	X (M)	Y (M)	Z (M)	Y - DIRECTION FORCE (KN)	X (M)	Y (M)	Z (M)	Z - DIRECTION FORCE (KN)	X (M)	Y (M)	Z (M)
91	SX05	-4505.38	24.71	-0.09	-11.79	COUPLE	0.04	0.00	-0.32	-17514.37	7.61	0.04	-10.94
92	SX06	-3643.70	29.42	-0.31	-11.13	-3253.12	5.24	27.34	-8.81	-17490.78	7.60	0.15	-10.97
93	SX07	COUPLE	0.04	0.00	-0.30	-4856.72	5.52	18.43	-8.41	-17342.54	7.50	0.22	-10.97
94	SX08	4461.96	-14.35	-0.17	-9.61	-4020.33	5.68	22.25	-11.09	-17368.65	7.38	0.18	-10.88

JOINT CAN SUMMARY
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL UC	DESIGN DIAMETER (CM)	DESIGN THICKNESS (CM)	DESIGN YLD STRS (N/MM2)	DESIGN UC
2210	45.720	0.953	326.005	0.812	45.720	0.953	326.005	0.812
1190	21.900	0.800	248.000	0.806	21.900	0.800	248.000	0.806
2230	45.720	0.953	326.005	0.754	45.720	0.953	326.005	0.754
1199	21.900	0.800	248.000	0.709	21.900	0.800	248.000	0.709
3325	45.720	1.200	326.005	0.692	45.720	1.200	326.005	0.692
2220	45.720	0.953	326.005	0.669	45.720	0.953	326.005	0.669
7179	27.300	0.635	248.000	0.592	27.300	0.635	248.000	0.592
2100	151.800	3.500	326.005	0.588	151.800	3.500	326.005	0.588
2300	151.800	3.500	326.005	0.565	151.800	3.500	326.005	0.565
3326	45.720	1.200	326.005	0.534	45.720	1.200	326.005	0.534
3909	45.720	1.200	326.005	0.486	45.720	1.200	326.005	0.486
2400	151.800	3.500	326.005	0.470	151.800	3.500	326.005	0.470
2221	45.720	0.953	326.005	0.460	45.720	0.953	326.005	0.460
1198	21.900	0.800	248.000	0.450	21.900	0.800	248.000	0.450
5200	153.000	4.100	326.005	0.446	153.000	4.100	326.005	0.446
5400	153.000	4.100	326.005	0.441	153.000	4.100	326.005	0.441
3400	151.800	3.500	326.005	0.436	151.800	3.500	326.005	0.436
3200	151.800	3.500	326.005	0.435	151.800	3.500	326.005	0.435
4100	151.800	3.500	326.005	0.410	151.800	3.500	326.005	0.410
4300	151.800	3.500	326.005	0.409	151.800	3.500	326.005	0.409
4400	151.800	3.500	326.005	0.405	151.800	3.500	326.005	0.405
1168	21.900	0.800	248.000	0.392	21.900	0.800	248.000	0.392
1203	40.000	1.600	326.005	0.389	40.000	1.600	326.005	0.389
3910	45.720	1.200	326.005	0.380	45.720	1.200	326.005	0.380
4401	148.000	1.600	326.005	0.375	148.000	1.600	326.005	0.375
3100	151.800	3.500	326.005	0.374	151.800	3.500	326.005	0.374
4101	148.000	1.600	326.005	0.371	148.000	1.600	326.005	0.371
4200	151.800	3.500	326.005	0.367	151.800	3.500	326.005	0.367
3328	27.305	1.270	326.005	0.364	27.305	1.270	326.005	0.364
2200	151.800	3.500	326.005	0.358	151.800	3.500	326.005	0.358
5100	153.000	4.100	326.005	0.351	153.000	4.100	326.005	0.351
5300	153.000	4.100	326.005	0.351	153.000	4.100	326.005	0.351
3327	27.305	1.270	326.005	0.350	27.305	1.270	326.005	0.350
3320	27.300	1.270	248.000	0.347	27.300	1.270	248.000	0.347
1166	40.000	1.600	326.005	0.339	40.000	1.600	326.005	0.339
3318	27.300	1.270	248.000	0.322	27.300	1.270	248.000	0.322
3300	151.800	3.500	326.005	0.317	151.800	3.500	326.005	0.317
4201	148.000	1.600	326.005	0.310	148.000	1.600	326.005	0.310
1700	40.000	1.600	326.005	0.310	40.000	1.600	326.005	0.310
1790	148.000	1.600	326.005	0.300	148.000	1.600	326.005	0.300
3329	27.305	1.270	326.005	0.292	27.305	1.270	326.005	0.292
3912	45.720	1.200	326.005	0.291	45.720	1.200	326.005	0.291
1164	21.900	0.800	248.000	0.290	21.900	0.800	248.000	0.290
1927	31.800	1.300	326.005	0.290	31.800	1.300	326.005	0.290
4301	148.000	1.600	326.005	0.290	148.000	1.600	326.005	0.290
1225	32.400	1.600	248.000	0.285	32.400	1.600	248.000	0.285
1200	153.670	4.400	326.005	0.283	153.670	4.400	326.005	0.283
4909	60.960	1.270	326.005	0.282	60.960	1.270	326.005	0.282
1400	153.670	4.400	326.005	0.276	153.670	4.400	326.005	0.276
1197	21.900	0.800	248.000	0.274	21.900	0.800	248.000	0.274

JOINT CAN SUMMARY
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL UC	DESIGN DIAMETER (CM)	DESIGN THICKNESS (CM)	DESIGN YLD STRS (N/MM2)	DESIGN UC
1937	31.800	1.300	326.005	0.273	31.800	1.300	326.005	0.273
6300	76.200	3.800	326.005	0.271	76.200	3.800	326.005	0.271
4910	60.960	1.270	326.005	0.267	60.960	1.270	326.005	0.267
1188	21.900	0.800	248.000	0.267	21.900	0.800	248.000	0.267
1909	40.000	1.600	326.005	0.267	40.000	1.600	326.005	0.267
3907	45.720	1.200	326.005	0.266	45.720	1.200	326.005	0.266
6100	76.200	3.800	326.005	0.263	76.200	3.800	326.005	0.263
1910	40.000	1.600	326.005	0.262	40.000	1.600	326.005	0.262
3319	27.300	1.270	248.000	0.262	27.300	1.270	248.000	0.262
3925	32.400	1.600	326.005	0.255	32.400	1.600	326.005	0.255
1162	31.800	1.300	326.005	0.253	31.800	1.300	326.005	0.253
1926	31.800	1.300	326.005	0.253	31.800	1.300	326.005	0.253
3321	27.300	1.270	248.000	0.251	27.300	1.270	248.000	0.251
1100	153.670	4.400	326.005	0.251	153.670	4.400	326.005	0.251
1911	40.000	1.600	326.005	0.250	40.000	1.600	326.005	0.250
4350	60.960	1.270	326.005	0.249	60.960	1.270	326.005	0.249
1912	40.000	1.600	326.005	0.247	40.000	1.600	326.005	0.247
1180	31.800	1.300	326.005	0.244	31.800	1.300	326.005	0.244
2601	148.000	1.600	326.005	0.242	148.000	1.600	326.005	0.242
1196	21.900	0.800	248.000	0.242	21.900	0.800	248.000	0.242
3939	32.400	1.600	326.005	0.240	32.400	1.600	326.005	0.240
4150	60.960	1.270	326.005	0.240	60.960	1.270	326.005	0.240
1215	32.400	1.600	248.000	0.238	32.400	1.600	248.000	0.238
1182	40.000	1.600	326.005	0.238	40.000	1.600	326.005	0.238
8016	32.380	1.113	248.000	0.237	32.380	1.113	248.000	0.237
1184	21.900	0.800	248.000	0.237	21.900	0.800	248.000	0.237
1908	40.000	1.600	326.005	0.231	40.000	1.600	326.005	0.231
1189	40.000	1.600	326.005	0.227	40.000	1.600	326.005	0.227
5933	27.305	1.270	326.005	0.226	27.305	1.270	326.005	0.226
3911	45.720	1.200	326.005	0.225	45.720	1.200	326.005	0.225
4912	60.960	1.270	326.005	0.221	60.960	1.270	326.005	0.221
1300	153.670	4.400	326.005	0.218	153.670	4.400	326.005	0.218
1186	21.900	0.800	248.000	0.216	21.900	0.800	248.000	0.216
1181	21.900	0.800	248.000	0.214	21.900	0.800	248.000	0.214
3309	27.300	1.270	248.000	0.214	27.300	1.270	248.000	0.214
8300	76.200	4.400	326.005	0.214	76.200	4.400	326.005	0.214
3927	32.400	1.600	326.005	0.213	32.400	1.600	326.005	0.213
2907	45.720	1.600	326.005	0.212	45.720	1.600	326.005	0.212
6400	76.200	3.800	326.005	0.211	76.200	3.800	326.005	0.211
5929	27.305	1.270	326.005	0.211	27.305	1.270	326.005	0.211
4907	60.960	1.270	326.005	0.210	60.960	1.270	326.005	0.210
1907	40.000	1.600	326.005	0.210	40.000	1.600	326.005	0.210
2937	35.560	1.587	326.005	0.206	35.560	1.587	326.005	0.206
1192	21.900	0.800	248.000	0.204	21.900	0.800	248.000	0.204
3324	27.300	1.270	248.000	0.203	27.300	1.270	248.000	0.203
8100	76.200	4.400	326.005	0.202	76.200	4.400	326.005	0.202
1240	40.000	1.600	326.005	0.200	40.000	1.600	326.005	0.200
2927	35.560	1.587	326.005	0.198	35.560	1.587	326.005	0.198
1340	40.000	1.600	326.005	0.198	40.000	1.600	326.005	0.198
3317	27.300	1.270	248.000	0.196	27.300	1.270	248.000	0.196

JOINT CAN SUMMARY
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL UC	DESIGN DIAMETER (CM)	DESIGN THICKNESS (CM)	DESIGN YLD STRS (N/MM2)	DESIGN UC
3700	40.640	1.905	326.005	0.196	40.640	1.905	326.005	0.196
3323	27.300	1.270	248.000	0.195	27.300	1.270	248.000	0.195
4908	60.960	1.270	326.005	0.194	60.960	1.270	326.005	0.194
2938	35.560	1.587	326.005	0.192	35.560	1.587	326.005	0.192
2926	35.560	1.587	326.005	0.191	35.560	1.587	326.005	0.191
3313	27.300	1.270	248.000	0.190	27.300	1.270	248.000	0.190
4457	60.960	1.270	326.005	0.190	60.960	1.270	326.005	0.190
3322	27.300	1.270	248.000	0.190	27.300	1.270	248.000	0.190
1938	31.800	1.300	326.005	0.188	31.800	1.300	326.005	0.188
2909	45.720	1.600	326.005	0.188	45.720	1.600	326.005	0.188
4911	60.960	1.270	326.005	0.185	60.960	1.270	326.005	0.185
4458	60.960	1.270	326.005	0.183	60.960	1.270	326.005	0.183
5944	27.305	1.270	326.005	0.182	27.305	1.270	326.005	0.182
3937	32.400	1.600	326.005	0.182	32.400	1.600	326.005	0.182
5916	27.305	1.270	326.005	0.178	27.305	1.270	326.005	0.178
1230	40.000	1.600	326.005	0.177	40.000	1.600	326.005	0.177
2910	45.720	1.600	326.005	0.177	45.720	1.600	326.005	0.177
8400	76.200	4.400	326.005	0.175	76.200	4.400	326.005	0.175
1204	40.000	1.600	326.005	0.172	40.000	1.600	326.005	0.172
1210	40.000	1.600	326.005	0.171	40.000	1.600	326.005	0.171
1154	32.385	1.590	326.005	0.170	32.385	1.590	326.005	0.170
6200	76.200	3.800	326.005	0.170	76.200	3.800	326.005	0.170
8000	32.400	0.952	248.000	0.168	32.400	0.952	248.000	0.168
5923	27.305	1.270	326.005	0.167	27.305	1.270	326.005	0.167
1825	32.385	1.590	326.005	0.167	32.385	1.590	326.005	0.167
5931	27.305	1.270	326.005	0.166	27.305	1.270	326.005	0.166
1815	32.385	1.590	326.005	0.165	32.385	1.590	326.005	0.165
3908	45.720	1.200	326.005	0.164	45.720	1.200	326.005	0.164
3314	27.300	1.270	248.000	0.163	27.300	1.270	248.000	0.163
1145	32.400	1.270	248.000	0.162	32.400	1.270	248.000	0.162
1178	21.900	0.800	248.000	0.162	21.900	0.800	248.000	0.162
1814	32.385	1.590	326.005	0.160	32.385	1.590	326.005	0.160
1220	40.000	1.600	326.005	0.160	40.000	1.600	326.005	0.160
8062	32.380	1.113	248.000	0.157	32.380	1.113	248.000	0.157
1174	21.900	0.800	248.000	0.156	21.900	0.800	248.000	0.156
5921	27.305	1.270	326.005	0.155	27.305	1.270	326.005	0.155
2912	45.720	1.600	326.005	0.153	45.720	1.600	326.005	0.153
6101	148.000	1.600	326.005	0.153	148.000	1.600	326.005	0.153
5940	27.305	1.270	326.005	0.152	27.305	1.270	326.005	0.152
1824	32.385	1.590	326.005	0.149	32.385	1.590	326.005	0.149
5922	27.305	1.270	326.005	0.149	27.305	1.270	326.005	0.149
5934	27.305	1.270	326.005	0.149	27.305	1.270	326.005	0.149
1149	32.400	1.270	248.000	0.148	32.400	1.270	248.000	0.148
2225	32.400	1.430	326.005	0.147	32.400	1.430	326.005	0.147
1153	32.385	1.590	326.005	0.147	32.385	1.590	326.005	0.147
1193	21.900	0.800	248.000	0.145	21.900	0.800	248.000	0.145
2700	40.600	2.540	326.005	0.143	40.600	2.540	326.005	0.143
5941	27.305	1.270	326.005	0.143	27.305	1.270	326.005	0.143
2908	45.720	1.600	326.005	0.142	45.720	1.600	326.005	0.142
1160	40.000	1.600	326.005	0.140	40.000	1.600	326.005	0.140

JOINT CAN SUMMARY
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL UC	DESIGN DIAMETER (CM)	DESIGN THICKNESS (CM)	DESIGN YLD STRS (N/MM2)	DESIGN UC
1191	40.000	1.600	326.005	0.139	40.000	1.600	326.005	0.139
5930	27.305	1.270	326.005	0.137	27.305	1.270	326.005	0.137
1962	40.000	1.600	326.005	0.137	40.000	1.600	326.005	0.137
1205	40.000	1.600	326.005	0.137	40.000	1.600	326.005	0.137
1143	32.400	1.270	248.000	0.137	32.400	1.270	248.000	0.137
8200	76.200	4.400	326.005	0.135	76.200	4.400	326.005	0.135
5924	27.305	1.270	326.005	0.135	27.305	1.270	326.005	0.135
2925	35.560	1.587	326.005	0.135	35.560	1.587	326.005	0.135
1187	40.000	1.600	326.005	0.134	40.000	1.600	326.005	0.134
2215	32.400	1.430	326.005	0.132	32.400	1.430	326.005	0.132
3150	45.720	1.588	326.005	0.132	45.720	1.588	326.005	0.132
4700	35.560	1.588	326.005	0.130	35.560	1.588	326.005	0.130
2911	45.720	1.600	326.005	0.130	45.720	1.600	326.005	0.130
3934	27.305	1.270	326.005	0.129	27.305	1.270	326.005	0.129
5932	27.305	1.270	326.005	0.128	27.305	1.270	326.005	0.128
5913	27.305	1.270	326.005	0.126	27.305	1.270	326.005	0.126
2939	35.560	1.587	326.005	0.125	35.560	1.587	326.005	0.125
3305	27.300	1.270	248.000	0.124	27.300	1.270	248.000	0.124
3350	45.720	1.588	326.005	0.123	45.720	1.588	326.005	0.123
5915	27.305	1.270	326.005	0.122	27.305	1.270	326.005	0.122
7417	121.900	2.540	248.000	0.121	121.900	2.540	248.000	0.121
5942	27.305	1.270	326.005	0.120	27.305	1.270	326.005	0.120
2350	45.720	1.905	326.005	0.120	45.720	1.905	326.005	0.120
1812	26.700	1.300	326.005	0.120	26.700	1.300	326.005	0.120
5909	60.960	3.800	326.005	0.117	60.960	3.800	326.005	0.117
1179	40.000	1.600	326.005	0.117	40.000	1.600	326.005	0.117
1185	40.000	1.600	326.005	0.116	40.000	1.600	326.005	0.116
5935	27.305	1.270	326.005	0.115	27.305	1.270	326.005	0.115
5700	60.960	3.800	326.005	0.115	60.960	3.800	326.005	0.115
5910	60.960	3.800	326.005	0.115	60.960	3.800	326.005	0.115
4925	32.400	1.600	326.005	0.114	32.400	1.600	326.005	0.114
1822	26.700	1.300	326.005	0.114	26.700	1.300	326.005	0.114
2150	45.720	1.905	326.005	0.113	45.720	1.905	326.005	0.113
5917	27.305	1.270	326.005	0.113	27.305	1.270	326.005	0.113
4450	27.300	1.270	248.000	0.112	27.300	1.270	248.000	0.112
5943	27.305	1.270	326.005	0.112	27.305	1.270	326.005	0.112
3929	27.305	1.270	326.005	0.111	27.305	1.270	326.005	0.111
5918	27.305	1.270	326.005	0.111	27.305	1.270	326.005	0.111
3303	27.300	1.270	248.000	0.110	27.300	1.270	248.000	0.110
5914	27.305	1.270	326.005	0.109	27.305	1.270	326.005	0.109
5920	27.305	1.270	326.005	0.109	27.305	1.270	326.005	0.109
4939	32.400	1.600	326.005	0.109	32.400	1.600	326.005	0.109
1828	26.700	1.300	326.005	0.108	26.700	1.300	326.005	0.108
4449	27.300	1.270	248.000	0.108	27.300	1.270	248.000	0.108
5936	27.305	1.270	326.005	0.106	27.305	1.270	326.005	0.106
1141	32.400	1.270	248.000	0.105	32.400	1.270	248.000	0.105
1195	40.000	1.600	326.005	0.105	40.000	1.600	326.005	0.105
1147	32.400	1.270	248.000	0.104	32.400	1.270	248.000	0.104
8517	137.200	3.800	248.000	0.103	137.200	3.800	248.000	0.103
1818	26.700	1.300	326.005	0.103	26.700	1.300	326.005	0.103

JOINT CAN SUMMARY
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL UC	DESIGN DIAMETER (CM)	DESIGN THICKNESS (CM)	DESIGN YLD STRS (N/MM2)	DESIGN UC
1170	40.000	1.600	326.005	0.099	40.000	1.600	326.005	0.099
5939	40.600	3.800	326.005	0.098	40.600	3.800	326.005	0.098
5925	40.600	3.800	326.005	0.098	40.600	3.800	326.005	0.098
1183	40.000	1.600	326.005	0.097	40.000	1.600	326.005	0.097
4451	27.300	1.270	248.000	0.097	27.300	1.270	248.000	0.097
5912	60.960	3.800	326.005	0.096	60.960	3.800	326.005	0.096
3926	32.400	1.600	326.005	0.094	32.400	1.600	326.005	0.094
4448	27.300	1.270	248.000	0.094	27.300	1.270	248.000	0.094
4446	27.300	1.270	248.000	0.093	27.300	1.270	248.000	0.093
1176	40.000	1.600	326.005	0.092	40.000	1.600	326.005	0.092
3917	27.305	1.270	326.005	0.090	27.305	1.270	326.005	0.090
4927	32.400	1.600	326.005	0.090	32.400	1.600	326.005	0.090
1827	26.700	1.300	326.005	0.089	26.700	1.300	326.005	0.089
4452	27.300	1.270	248.000	0.088	27.300	1.270	248.000	0.088
5907	60.960	3.800	326.005	0.088	60.960	3.800	326.005	0.088
3913	27.305	1.270	326.005	0.087	27.305	1.270	326.005	0.087
2961	40.600	1.900	326.005	0.087	40.600	1.900	326.005	0.087
1156	26.700	1.300	326.005	0.087	26.700	1.300	326.005	0.087
1949	40.000	1.600	326.005	0.086	40.000	1.600	326.005	0.086
4438	27.300	1.270	248.000	0.086	27.300	1.270	248.000	0.086
4453	27.300	1.270	248.000	0.086	27.300	1.270	248.000	0.086
1150	40.000	1.600	326.005	0.085	40.000	1.600	326.005	0.085
4442	27.300	1.270	248.000	0.085	27.300	1.270	248.000	0.085
1961	40.000	1.600	326.005	0.083	40.000	1.600	326.005	0.083
4937	32.400	1.600	326.005	0.083	32.400	1.600	326.005	0.083
1139	32.400	1.270	248.000	0.083	32.400	1.270	248.000	0.083
4447	27.300	1.270	248.000	0.083	27.300	1.270	248.000	0.083
1172	40.000	1.600	326.005	0.083	40.000	1.600	326.005	0.083
5938	40.600	3.800	326.005	0.082	40.600	3.800	326.005	0.082
5926	40.600	3.800	326.005	0.082	40.600	3.800	326.005	0.082
5908	60.960	3.800	326.005	0.081	60.960	3.800	326.005	0.081
4456	27.305	1.270	326.005	0.080	27.305	1.270	326.005	0.080
3932	27.305	1.270	326.005	0.080	27.305	1.270	326.005	0.080
1152	26.700	1.300	326.005	0.079	26.700	1.300	326.005	0.079
4454	27.305	1.270	326.005	0.079	27.305	1.270	326.005	0.079
1151	26.700	1.300	326.005	0.078	26.700	1.300	326.005	0.078
1950	40.000	1.600	326.005	0.078	40.000	1.600	326.005	0.078
3922	27.305	1.270	326.005	0.078	27.305	1.270	326.005	0.078
5222	60.960	3.800	326.005	0.077	60.960	3.800	326.005	0.077
4455	27.305	1.270	326.005	0.077	27.305	1.270	326.005	0.077
3931	27.305	1.270	326.005	0.077	27.305	1.270	326.005	0.077
5190	60.960	3.800	326.005	0.076	60.960	3.800	326.005	0.076
2950	40.600	1.900	326.005	0.076	40.600	1.900	326.005	0.076
3935	27.305	1.270	326.005	0.075	27.305	1.270	326.005	0.075
5911	60.960	3.800	326.005	0.075	60.960	3.800	326.005	0.075
1817	26.700	1.300	326.005	0.075	26.700	1.300	326.005	0.075
1155	26.700	1.300	326.005	0.075	26.700	1.300	326.005	0.075
5927	40.600	3.800	326.005	0.075	40.600	3.800	326.005	0.075
1142	32.400	1.270	248.000	0.074	32.400	1.270	248.000	0.074
1821	26.700	1.300	326.005	0.074	26.700	1.300	326.005	0.074

JOINT CAN SUMMARY
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL UC	DESIGN DIAMETER (CM)	DESIGN THICKNESS (CM)	DESIGN YLD STRS (N/MM2)	DESIGN UC
5937	40.600	3.800	326.005	0.074	40.600	3.800	326.005	0.074
2949	40.600	1.900	326.005	0.074	40.600	1.900	326.005	0.074
1939	40.000	2.200	326.005	0.074	40.000	2.200	326.005	0.074
3308	27.300	1.270	248.000	0.074	27.300	1.270	248.000	0.074
3307	27.300	1.270	248.000	0.072	27.300	1.270	248.000	0.072
1144	32.400	1.270	248.000	0.072	32.400	1.270	248.000	0.072
3923	27.305	1.270	326.005	0.072	27.305	1.270	326.005	0.072
7541	121.900	2.540	248.000	0.071	121.900	2.540	248.000	0.071
3938	32.400	1.600	326.005	0.070	32.400	1.600	326.005	0.070
2942	27.305	1.600	326.005	0.069	27.305	1.600	326.005	0.069
5350	60.960	3.800	326.005	0.069	60.960	3.800	326.005	0.069
8065	32.380	1.113	248.000	0.069	32.380	1.113	248.000	0.069
2920	27.305	1.600	326.005	0.069	27.305	1.600	326.005	0.069
2914	27.305	1.600	326.005	0.069	27.305	1.600	326.005	0.069
5150	60.960	3.800	326.005	0.069	60.960	3.800	326.005	0.069
2913	27.305	1.600	326.005	0.068	27.305	1.600	326.005	0.068
1140	32.400	1.270	248.000	0.067	32.400	1.270	248.000	0.067
3315	27.300	1.270	248.000	0.067	27.300	1.270	248.000	0.067
2962	40.600	1.900	326.005	0.067	40.600	1.900	326.005	0.067
3924	27.305	1.270	326.005	0.067	27.305	1.270	326.005	0.067
1811	26.700	1.300	326.005	0.067	26.700	1.300	326.005	0.067
5220	40.600	3.800	326.005	0.067	40.600	3.800	326.005	0.067
3944	27.305	1.270	326.005	0.067	27.305	1.270	326.005	0.067
3942	27.305	1.270	326.005	0.067	27.305	1.270	326.005	0.067
5188	40.600	3.800	326.005	0.067	40.600	3.800	326.005	0.067
3312	27.300	1.270	248.000	0.066	27.300	1.270	248.000	0.066
1148	32.400	1.270	248.000	0.065	32.400	1.270	248.000	0.065
1138	32.400	1.270	248.000	0.065	32.400	1.270	248.000	0.065
1350	40.000	1.600	326.005	0.065	40.000	1.600	326.005	0.065
1146	32.400	1.270	248.000	0.064	32.400	1.270	248.000	0.064
1925	40.000	2.200	326.005	0.064	40.000	2.200	326.005	0.064
2934	27.305	1.600	326.005	0.063	27.305	1.600	326.005	0.063
3921	27.305	1.270	326.005	0.062	27.305	1.270	326.005	0.062
2915	27.305	1.600	326.005	0.062	27.305	1.600	326.005	0.062
3940	27.305	1.270	326.005	0.061	27.305	1.270	326.005	0.061
3306	27.300	1.270	248.000	0.060	27.300	1.270	248.000	0.060
3933	27.305	1.270	326.005	0.060	27.305	1.270	326.005	0.060
3920	27.305	1.270	326.005	0.060	27.305	1.270	326.005	0.060
5124	60.960	3.800	326.005	0.059	60.960	3.800	326.005	0.059
3304	27.300	1.270	248.000	0.059	27.300	1.270	248.000	0.059
1194	40.000	1.600	326.005	0.058	40.000	1.600	326.005	0.058
2936	27.305	1.600	326.005	0.058	27.305	1.600	326.005	0.058
5310	60.960	3.800	326.005	0.058	60.960	3.800	326.005	0.058
5172	40.600	3.800	326.005	0.057	40.600	3.800	326.005	0.057
2944	27.305	1.600	326.005	0.057	27.305	1.600	326.005	0.057
5106	60.960	3.800	326.005	0.057	60.960	3.800	326.005	0.057
4431	27.300	1.270	248.000	0.057	27.300	1.270	248.000	0.057
5252	40.600	3.800	326.005	0.057	40.600	3.800	326.005	0.057
2918	27.305	1.600	326.005	0.057	27.305	1.600	326.005	0.057
4444	27.300	1.270	248.000	0.057	27.300	1.270	248.000	0.057

JOINT CAN SUMMARY
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL UC	DESIGN DIAMETER (CM)	DESIGN THICKNESS (CM)	DESIGN YLD STRS (N/MM2)	DESIGN UC
3915	27.305	1.270	326.005	0.057	27.305	1.270	326.005	0.057
4437	27.300	1.270	248.000	0.056	27.300	1.270	248.000	0.056
4439	27.300	1.270	248.000	0.056	27.300	1.270	248.000	0.056
4926	32.400	1.600	326.005	0.056	32.400	1.600	326.005	0.056
2928	27.305	1.600	326.005	0.056	27.305	1.600	326.005	0.056
4433	27.300	1.270	248.000	0.056	27.300	1.270	248.000	0.056
4436	27.300	1.270	248.000	0.055	27.300	1.270	248.000	0.055
4441	27.300	1.270	248.000	0.055	27.300	1.270	248.000	0.055
2916	27.305	1.600	326.005	0.055	27.305	1.600	326.005	0.055
4434	27.300	1.270	248.000	0.055	27.300	1.270	248.000	0.055
5306	40.600	3.800	326.005	0.055	40.600	3.800	326.005	0.055
5258	40.600	3.800	326.005	0.055	40.600	3.800	326.005	0.055
5212	60.960	3.800	326.005	0.055	60.960	3.800	326.005	0.055
5240	40.600	3.800	326.005	0.055	40.600	3.800	326.005	0.055
5164	40.600	3.800	326.005	0.055	40.600	3.800	326.005	0.055
5178	40.600	3.800	326.005	0.054	40.600	3.800	326.005	0.054
5308	60.960	3.800	326.005	0.054	60.960	3.800	326.005	0.054
5228	60.960	3.800	326.005	0.054	60.960	3.800	326.005	0.054
2940	27.305	1.600	326.005	0.054	27.305	1.600	326.005	0.054
3301	27.300	1.270	248.000	0.054	27.300	1.270	248.000	0.054
3936	27.305	1.270	326.005	0.053	27.305	1.270	326.005	0.053
3943	27.305	1.270	326.005	0.053	27.305	1.270	326.005	0.053
1206	40.000	1.600	326.005	0.053	40.000	1.600	326.005	0.053
5254	40.600	3.800	326.005	0.052	40.600	3.800	326.005	0.052
4938	32.400	1.600	326.005	0.052	32.400	1.600	326.005	0.052
5232	60.960	3.800	326.005	0.052	60.960	3.800	326.005	0.052
5204	60.960	3.800	326.005	0.052	60.960	3.800	326.005	0.052
5122	40.600	3.800	326.005	0.051	40.600	3.800	326.005	0.051
5242	60.960	3.800	326.005	0.051	60.960	3.800	326.005	0.051
5244	40.600	3.800	326.005	0.050	40.600	3.800	326.005	0.050
5180	60.960	3.800	326.005	0.050	60.960	3.800	326.005	0.050
5174	40.600	3.800	326.005	0.050	40.600	3.800	326.005	0.050
4432	27.300	1.270	248.000	0.050	27.300	1.270	248.000	0.050
2930	27.305	1.600	326.005	0.049	27.305	1.600	326.005	0.049
4443	27.300	1.270	248.000	0.049	27.300	1.270	248.000	0.049
2922	27.305	1.600	326.005	0.049	27.305	1.600	326.005	0.049
5198	40.600	3.800	326.005	0.049	40.600	3.800	326.005	0.049
5234	40.600	3.800	326.005	0.049	40.600	3.800	326.005	0.049
5286	60.960	3.800	326.005	0.049	60.960	3.800	326.005	0.049
5312	60.960	3.800	326.005	0.048	60.960	3.800	326.005	0.048
5218	60.960	3.800	326.005	0.048	60.960	3.800	326.005	0.048
5186	60.960	3.800	326.005	0.048	60.960	3.800	326.005	0.048
5108	60.960	3.800	326.005	0.048	60.960	3.800	326.005	0.048
5192	40.600	3.800	326.005	0.048	40.600	3.800	326.005	0.048
5130	60.960	3.800	326.005	0.047	60.960	3.800	326.005	0.047
5268	40.600	3.800	326.005	0.047	40.600	3.800	326.005	0.047
5154	40.600	3.800	326.005	0.046	40.600	3.800	326.005	0.046
3918	27.305	1.270	326.005	0.046	27.305	1.270	326.005	0.046
5260	60.960	3.800	326.005	0.045	60.960	3.800	326.005	0.045
5166	60.960	3.800	326.005	0.045	60.960	3.800	326.005	0.045

JOINT CAN SUMMARY
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL UC	DESIGN DIAMETER (CM)	DESIGN THICKNESS (CM)	DESIGN YLD STRS (N/MM2)	DESIGN UC
5194	60.960	3.800	326.005	0.044	60.960	3.800	326.005	0.044
3914	27.305	1.270	326.005	0.043	27.305	1.270	326.005	0.043
5246	60.960	3.800	326.005	0.043	60.960	3.800	326.005	0.043
1222	40.000	1.600	326.005	0.042	40.000	1.600	326.005	0.042
5276	60.960	3.800	326.005	0.041	60.960	3.800	326.005	0.041
5156	60.960	3.800	326.005	0.040	60.960	3.800	326.005	0.040
5270	60.960	3.800	326.005	0.040	60.960	3.800	326.005	0.040
5140	60.960	3.800	326.005	0.040	60.960	3.800	326.005	0.040
530	153.670	4.400	326.005	0.040	153.670	4.400	326.005	0.040
5230	40.600	3.800	326.005	0.039	40.600	3.800	326.005	0.039
5142	40.600	3.800	326.005	0.039	40.600	3.800	326.005	0.039
5288	40.600	3.800	326.005	0.039	40.600	3.800	326.005	0.039
5210	40.600	3.800	326.005	0.038	40.600	3.800	326.005	0.038
5278	40.600	3.800	326.005	0.038	40.600	3.800	326.005	0.038
520	153.670	4.400	326.005	0.038	153.670	4.400	326.005	0.038
5132	40.600	3.800	326.005	0.038	40.600	3.800	326.005	0.038
5128	60.960	3.800	326.005	0.037	60.960	3.800	326.005	0.037
5280	60.960	3.800	326.005	0.037	60.960	3.800	326.005	0.037
5144	60.960	3.800	326.005	0.037	60.960	3.800	326.005	0.037
5138	60.960	3.800	326.005	0.037	60.960	3.800	326.005	0.037
2924	27.305	1.600	326.005	0.037	27.305	1.600	326.005	0.037
3941	27.305	1.270	326.005	0.036	27.305	1.270	326.005	0.036
2932	27.305	1.600	326.005	0.036	27.305	1.600	326.005	0.036
5266	60.960	3.800	326.005	0.036	60.960	3.800	326.005	0.036
5256	60.960	3.800	326.005	0.036	60.960	3.800	326.005	0.036
5236	60.960	3.800	326.005	0.036	60.960	3.800	326.005	0.036
2600	66.000	2.500	326.005	0.035	66.000	2.500	326.005	0.035
5238	60.960	3.800	326.005	0.035	60.960	3.800	326.005	0.035
5294	60.960	3.800	326.005	0.035	60.960	3.800	326.005	0.035
5152	60.960	3.800	326.005	0.035	60.960	3.800	326.005	0.035
5196	60.960	3.800	326.005	0.035	60.960	3.800	326.005	0.035
5162	60.960	3.800	326.005	0.035	60.960	3.800	326.005	0.035
5148	60.960	3.800	326.005	0.034	60.960	3.800	326.005	0.034
5176	60.960	3.800	326.005	0.034	60.960	3.800	326.005	0.034
5284	60.960	3.800	326.005	0.034	60.960	3.800	326.005	0.034
5316	60.960	3.800	326.005	0.033	60.960	3.800	326.005	0.033
5120	60.960	3.800	326.005	0.033	60.960	3.800	326.005	0.033
5160	60.960	3.800	326.005	0.033	60.960	3.800	326.005	0.033
5112	60.960	3.800	326.005	0.032	60.960	3.800	326.005	0.032
5314	60.960	3.800	326.005	0.032	60.960	3.800	326.005	0.032
5274	60.960	3.800	326.005	0.032	60.960	3.800	326.005	0.032
5248	40.600	3.800	326.005	0.032	40.600	3.800	326.005	0.032
5290	60.960	3.800	326.005	0.032	60.960	3.800	326.005	0.032
5177	60.960	3.800	326.005	0.032	60.960	3.800	326.005	0.032
5134	60.960	3.800	326.005	0.031	60.960	3.800	326.005	0.031
5296	60.960	3.800	326.005	0.031	60.960	3.800	326.005	0.031
5170	60.960	3.800	326.005	0.031	60.960	3.800	326.005	0.031
5110	60.960	3.800	326.005	0.031	60.960	3.800	326.005	0.031
5104	60.960	3.800	326.005	0.031	60.960	3.800	326.005	0.031
5318	60.960	3.800	326.005	0.031	60.960	3.800	326.005	0.031

JOINT CAN SUMMARY
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL UC	DESIGN DIAMETER (CM)	DESIGN THICKNESS (CM)	DESIGN YLD STRS (N/MM2)	DESIGN UC
5264	60.960	3.800	326.005	0.031	60.960	3.800	326.005	0.031
5182	40.600	3.800	326.005	0.030	40.600	3.800	326.005	0.030
5322	60.960	3.800	326.005	0.030	60.960	3.800	326.005	0.030
5324	60.960	3.800	326.005	0.030	60.960	3.800	326.005	0.030
3916	32.400	1.600	326.005	0.030	32.400	1.600	326.005	0.030
5118	60.960	3.800	326.005	0.030	60.960	3.800	326.005	0.030
5114	60.960	3.800	326.005	0.030	60.960	3.800	326.005	0.030
5184	60.960	3.800	326.005	0.029	60.960	3.800	326.005	0.029
5250	60.960	3.800	326.005	0.029	60.960	3.800	326.005	0.029
5477	60.960	3.800	326.005	0.029	60.960	3.800	326.005	0.029
5116	60.960	3.800	326.005	0.029	60.960	3.800	326.005	0.029
5320	60.960	3.800	326.005	0.029	60.960	3.800	326.005	0.029
1791	61.000	3.200	326.005	0.027	61.000	3.200	326.005	0.027
5216	60.960	3.800	326.005	0.026	60.960	3.800	326.005	0.026
5226	60.960	3.800	326.005	0.026	60.960	3.800	326.005	0.026
5262	40.600	3.800	326.005	0.026	40.600	3.800	326.005	0.026
5214	40.600	3.800	326.005	0.025	40.600	3.800	326.005	0.025
5224	40.600	3.800	326.005	0.025	40.600	3.800	326.005	0.025
5168	40.600	3.800	326.005	0.024	40.600	3.800	326.005	0.024
5277	60.960	3.800	326.005	0.022	60.960	3.800	326.005	0.022
5136	40.600	3.800	326.005	0.022	40.600	3.800	326.005	0.022
5126	40.600	3.800	326.005	0.022	40.600	3.800	326.005	0.022
5272	40.600	3.800	326.005	0.021	40.600	3.800	326.005	0.021
5292	40.600	3.800	326.005	0.021	40.600	3.800	326.005	0.021
5158	40.600	3.800	326.005	0.021	40.600	3.800	326.005	0.021
5146	40.600	3.800	326.005	0.021	40.600	3.800	326.005	0.021
5282	40.600	3.800	326.005	0.021	40.600	3.800	326.005	0.021
5298	40.600	3.800	326.005	0.019	40.600	3.800	326.005	0.019
3945	32.400	1.600	326.005	0.019	32.400	1.600	326.005	0.019

APPENDIX C – Calculation & Spreadsheet Analysis

APPENDIX C.1: Wind Force Calculation

APPENDIX C.2: Wave and Current Spreadsheet

APPENDIX C.3: Spreadsheet on Wind Speed Analysis

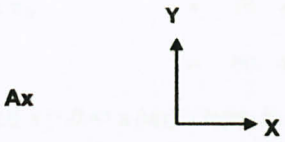
APPENDIX C.4: Spreadsheet on Wave Height Analysis

APPENDIX C.5: Spreadsheet on Wave Period Analysis

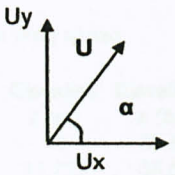
APPENDIX C.6: Spreadsheet on Current Velocity Analysis

APPENDIX C.1: Wind Force Calculation

OBLIQUE WIND FACTOR



Ay



Ax = enclosed deck area in x-direction
Ay = enclosed deck area in y-direction

U = wind velocity in oblique direction α from the x-axis
Ux = component of velocity in x-direction = U cos α
Uy = component of velocity in y-direction = U sin α

Wind force in x-direction due to Ux component of U,

$fx = I$, where K = constant

$= K (U \cos \alpha)^2 Ax$
$= K U^2 (\cos \alpha)^2 Ax$
$= (\cos \alpha)^2 K U^2 Ax$
$= (\cos \alpha)^2 Fx$, where Fx = force due to wind U in x-direction

Similarly,

$fy = (\sin \alpha)^2 Fy$, where Fy = force due to wind U in y-direction

WIND SPEED CALCULATION

Reference: API RP 2A-WSD 21st Edition

WIND CRITERIA

1 hour mean wind speed at 32.8 ft (10 m) above sea level, U_0 = 14.6 m/s = 47.90 ft/s

Reference height, z_0 = 10 m = 32.8 ft

Gust period, t = 60 sec

$$u(z/t) = U(z) \times [1\text{-}0.41 \times Iu(z) \times ln(t/t_0)] \quad (2.3.2\text{-}1)$$

where, $$U(z) = U_0 \times [1 + C \times ln(z/32.8)] \quad (2.3.2\text{-}2)$$

$$C = 5.73 \times 10^{-2} \times (1 + 0.0457 \times U_0)^{1/2}$$

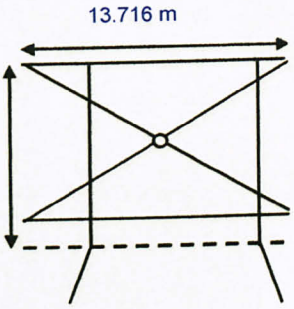
$$I_u(z) = 0.06 \times [1 + 0.0131 \times U_0] \times (z/32.8)^{-0.22} \quad (2.3.2\text{-}3)$$

Design wind speed,

Elevation z (m)	Elevation z (ft)	$I_u(z)$	C	$U(z)$	$u(z,t)$ (ft/s)	$u(z,t)$ (m/s)
10	32.8	0.0976	0.1023	47.90	55.75	17.0
11.735	38.5	0.0943	0.1023	48.68	56.39	17.2

Wind force, $F = (\rho/2)u^2 C_s A$; ρ = 1.226 kg/m^3 (2.3.2-8)

Elevation z (m)	Height (m)	Width (m)	C_s	Area (m^2)	F (kN)
11.74	10.06	13.7	1.0	137.96	24.98



For storm wind load, the following factor was applied

Factor = (Vstorm)2 / (Voperating)2
= $34^2 / 17^2$
= 4.000

WIND SPEED CALCULATION

Reference: API RP 2A-WSD 21st Edition

WIND CRITERIA

1 hour mean wind speed at 32.8 ft (10 m) above sea level, U_0 = 14.6 m/s = 47.90 ft/s

Reference height, z_0 = 10 m = 32.8 ft

Gust period, t = 60 sec

$$u(z/t) = U(z) \times [1\text{-}0.41 \times Iu(z) \times \ln(t/t_0)] \quad (2.3.2\text{-}1)$$

where, $$U(z) = U_0 \times [1 + C \times \ln(z/32.8)] \quad (2.3.2\text{-}2)$$

$$C = 5.73 \times 10^{-2} \times (1 + 0.0457 \times U_0)^{1/2}$$

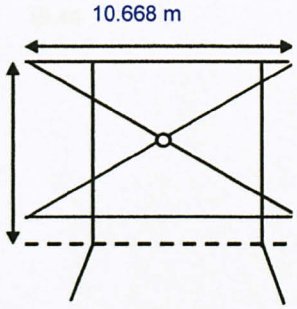
$$I_u(z) = 0.06 \times [1 + 0.0131 \times U_0] \times (z/32.8)^{-0.22} \quad (2.3.2\text{-}3)$$

Design wind speed,

Elevation z (m)	Elevation z (ft)	$I_u(z)$	C	$U(z)$	$u(z,t)$ (ft/s)	$u(z,t)$ (m/s)
10	32.8	0.0976	0.1023	47.90	55.75	17.0
11.735	38.5	0.0943	0.1023	48.68	56.39	17.2

Wind force, $F = (\rho/2)u^2 C_s A$; ρ = 1.226 kg/m^3 (2.3.2-8)

Elevation z (m)	Height (m)	Width (m)	C_s	Area (m^2)	F (kN)
11.74	10.06	10.7	1.0	107.30	19.43



For storm wind load, the following factor was applied

Factor = (Vstorm)2 / (Voperating)2
= $34^2 / 17^2$
= 4.000

Load Condition : **7**

Load Label : **WIND X**

Subject : **Wind load X direction**

No.	Location	No. of point	Weight	Total Weight
1	Production deck	4	3.12	12.48
2	Scrapper Deck	4	3.12	12.48
			TOTAL	24.96

Load Condition : **8**

Load Label : **WIND Y**

Subject : **Wind load Y direction**

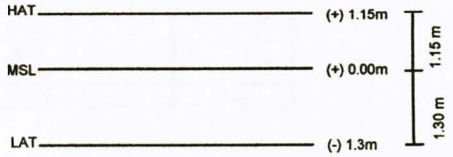
No.	Location	No. of point	Weight	Total Weight
1	Production deck	4	2.43	9.72
2	Scrapper Deck	4	2.43	9.72
			TOTAL	19.44

APPENDIX C.2: Wave and Current Spreadsheet

WAVE / CURRENT CRITERIA
PLATFORM : TBG-B

Tides / Design Water Depth

Highest Astronomical Tide (HAT) (+) 1.15m
Mean Sea Level (MSL) (+) 0.00m
Lowest Astronomical Tide (LAT) (-) 1.30m



Tides	Storm		Operating	
	ST_{max}	ST_{min}	OP_{max}	OP_{min}
MSL	85.65	85.65	85.65	85.65
HAT	1.15	-	1.15	-
LAT	-	-1.3	-	-1.3
Positive Storm Surge	0.60	-	0.30	-
Design Water Depth (m)	87.4	84.35	87.1	84.35

WAVE / CURRENT CRITERIA
PLATFORM : TBG-B

Current

ST_{max}
Water Depth = 87.4 m

	Return Period
Water level	100-year
87.4	2.23
65.55	2.03
43.7	1.77
21.85	1.41
0.874	0.82

ST_{min}
Water Depth = 84.35 m

	Return Period
Water level	100-year
84.35	2.23
63.2625	2.03
42.175	1.77
21.0875	1.41
0.844	0.82

OP_{max}
Water Depth = 87.1 m

	Return Period
Water level	1-year
87.1	1.55
65.325	1.41
43.55	1.23
21.775	0.98
0.871	0.57

OP_{min}
Water Depth = 84.35 m

	Return Period
Water level	1-year
84.35	1.55
63.2625	1.41
42.175	1.23
21.0875	0.98
0.844	0.57

MSL
Water Depth = 85.65 m

	Return Period	
Water level	1-year	100-year
85.65	1.55	2.23
64.2375	1.41	2.03
42.825	1.23	1.77
21.4125	0.98	1.41
0.857	0.57	0.82

WAVE / CURRENT CRITERIA
PLATFORM : TBG-B

Wave Theory (API - Fig. 2.3.1-3)

ST_{max}	I	II	III
H	12.1	10.2	5.4
T	9.4	8.9	6.7
d	87.4	87.4	87.4
V_I	2.23	2.23	2.23
d/gT^2	0.101	0.113	0.199
V_I / gT	0.024	0.026	0.034
$T_{app}/T = 1 + V_I/\sqrt{gd}$	1.08	1.08	1.08
T_{app}	**10.12**	**9.58**	**7.21**
Wave Steepness (H/gT_{app}^2)	0.012	0.011	0.011
Relative Water Depth (d/gT_{app}^2)	0.087	0.097	0.171
Wave Theory	Stokes	Stokes	Stokes

ST_{min}	I	II	III
H	12.1	10.2	5.4
T	9.4	8.9	6.7
d	84.35	84.35	84.35
V_I	2.23	2.23	2.23
d/gT^2	0.097	0.109	0.192
V_I / gT	0.024	0.026	0.034
$T_{app}/T = 1 + V_I/\sqrt{gd}$	1.08	1.08	1.08
T_{app}	**10.13**	**9.59**	**7.22**
Wave Steepness (H/gT_{app}^2)	0.012	0.011	0.011
Relative Water Depth (d/gT_{app}^2)	0.084	0.094	0.165
Wave Theory	Stokes	Stokes	Stokes

OP_{max}	I	II	III
H	6.1	5.2	2.8
T	7.3	6.6	4.7
d	87.1	87.1	87.1
V_I	1.55	1.55	1.55
d/gT^2	0.167	0.204	0.402
V_I / gT	0.022	0.024	0.034
$T_{app}/T = 1 + V_I/\sqrt{gd}$	1.05	1.05	1.05
T_{app}	**7.69**	**6.95**	**4.95**
Wave Steepness (H/gT_{app}^2)	0.011	0.011	0.012
Relative Water Depth (d/gT_{app}^2)	0.150	0.184	0.363
Wave Theory	Stokes	Stokes	Stokes

OP_{min}	I	II	III
H	6.1	5.2	2.8
T	7.3	6.6	4.7
d	84.35	84.35	84.35
V_I	1.55	1.55	1.55
d/gT^2	0.161	0.197	0.389
V_I / gT	0.022	0.024	0.034
$T_{app}/T = 1 + V_I/\sqrt{gd}$	1.05	1.05	1.05
T_{app}	**7.69**	**6.96**	**4.95**
Wave Steepness (H/gT_{app}^2)	0.011	0.011	0.012
Relative Water Depth (d/gT_{app}^2)	0.145	0.178	0.351
Wave Theory	Stokes	Stokes	Stokes

MSL	OP			ST		
	I	II	III	I	II	III
H	6.1	5.2	2.8	12.1	10.2	5.4
T	7.3	6.6	4.7	9.4	8.9	6.7
d	85.65	85.65	85.65	85.65	85.65	85.65
V_I	1.55	1.55	1.55	2.23	2.23	2.23
d/gT^2	0.164	0.200	0.395	0.099	0.110	0.195
V_I / gT	0.022	0.024	0.034	0.024	0.026	0.034
$T_{app}/T = 1 + V_I/\sqrt{gd}$	1.05	1.05	1.05	1.08	1.08	1.08
T_{app}	**7.69**	**6.95**	**4.95**	**10.12**	**9.58**	**7.22**
Wave Steepness (H/gT_{app}^2)	0.011	0.011	0.012	0.012	0.011	0.011
Relative Water Depth (d/gT_{app}^2)	0.148	0.181	0.356	0.085	0.095	0.168
Wave Theory	Stokes	Stokes	Stokes	Stokes	Stokes	Stokes

STmax	I	II	III
H	12.1	10.2	5.4
T	9.4	8.9	8.9
d	87.4	87.4	87.4
Vl	2.23	2.23	2.23
d/gT2	0.101	0.113	0.113
Vl / gT	0.024	0.026	0.026
Tapp/T = 1 + Vl/√gd	1.08	1.08	1.08
Tapp	**10.12**	**9.58**	**9.58**
Wave Steepness (H/gTapp2)	0.012	0.011	0.006
Relative Water Depth (d/gTapp2)	0.087	0.097	0.097
Wave Theory	Stokes	Stokes	Stokes

STmin	I	II	III
H	12.1	10.2	5.4
T	9.4	8.9	8.9
d	84.35	84.35	84.35
Vl	2.23	2.23	2.23
d/gT2	0.097	0.109	0.109
Vl / gT	0.024	0.026	0.026
Tapp/T = 1 + Vl/√gd	1.08	1.08	1.08
Tapp	**10.13**	**9.59**	**9.59**
Wave Steepness (H/gTapp2)	0.012	0.011	0.006
Relative Water Depth (d/gTapp2)	0.084	0.094	0.094
Wave Theory	Stokes	Stokes	Stokes

OP_{max}	I	II	III
H	6.1	5.2	2.8
T	8.5	8.9	10
d	87.1	87.1	87.1
V_l	1.55	1.55	1.55
d/gT^2	0.123	0.112	0.089
V_l / gT	0.019	0.018	0.016
$T_{app}/T = 1 + V_l/\sqrt{gd}$	1.05	1.05	1.05
T_{app}	**8.95**	**9.37**	**10.53**
Wave Steepness (H/gT_{app}^2)	0.008	0.006	0.003
Relative Water Depth (d/gT_{app}^2)	0.111	0.101	0.080
Wave Theory	Stokes	Stokes	Stokes

OP_{min}	I	II	III
H	6.1	5.2	2.8
T	8.5	8.9	10
d	84.35	84.35	84.35
V_l	1.55	1.55	1.55
d/gT^2	0.119	0.109	0.086
V_l / gT	0.019	0.018	0.016
$T_{app}/T = 1 + V_l/\sqrt{gd}$	1.05	1.05	1.05
T_{app}	**8.96**	**9.38**	**10.54**
Wave Steepness (H/gT_{app}^2)	0.008	0.006	0.003
Relative Water Depth (d/gT_{app}^2)	0.107	0.098	0.077
Wave Theory	Stokes	Stokes	Stokes

MSL	OP			ST		
	I	II	III	I	II	III
H	6.1	5.2	2.8	12.1	10.2	5.4
T	8.5	8.9	10	9.4	8.9	8.9
d	85.65	85.65	85.65	85.65	85.65	85.65
V_l	1.55	1.55	1.55	2.23	2.23	2.23
d/gT^2	0.121	0.110	0.087	0.099	0.110	0.110
V_l / gT	0.019	0.018	0.016	0.024	0.026	0.026
$T_{app}/T = 1 + V_l/\sqrt{gd}$	1.05	1.05	1.05	1.08	1.08	1.08
T_{app}	**8.95**	**9.38**	**10.53**	**10.12**	**9.58**	**9.58**
Wave Steepness (H/gT_{app}^2)	0.008	0.006	0.003	0.012	0.011	0.006
Relative Water Depth (d/gT_{app}^2)	0.109	0.099	0.079	0.085	0.095	0.095
Wave Theory	Stokes	Stokes	Stokes	Stokes	Stokes	Stokes

APPENDIX C.3: Spreadsheet on Wind Speed Analysis

WIND SPEED – OPERATING

Wind Speed Analysis - Operating Condition

Load Case Summary

wind speed (m/s)	Load (kN)	
	X-dir	Y- dir
16	22.16	17.28
18	28	21.76
20	34.52	26.848
22	41.84	32.552

Wind Speed Analysis - Operating Condition

Load Combination

Fx

Load Comb.	Forces (kN)			
	16	18	20	22
OP01	3642.561	3648.401	3654.921	3662.241
OP02	2859.157	2862.077	2865.337	2868.997
OP03	-16.675	-16.675	-16.675	-16.675
OP04	-2841.65	-2844.57	-2847.83	-2851.49
OP05	-3575.23	-3581.07	-3587.59	-3594.91
OP06	-2830.86	-2833.78	-2837.04	-2840.7
OP07	-2.673	-2.673	-2.673	-2.673
OP08	2849.479	2852.399	2855.659	2859.319
ST01	8208.044	8207.841	8207.644	8207.879
ST02	1432.485	1432.523	1432.285	1432.193
ST03	-18.029	-18.029	-18.029	-18.029
ST04	-1467.57	-1467.01	-1466.49	-1466.4
ST05	-4505.26	-4506.34	-4505.3	-4505.54
ST06	-3644.75	-3644.18	-3643.66	-3643.57
ST07	-17.973	-17.973	-17.973	-17.973
ST08	4462.123	4462.162	4461.923	4461.831
SX01	8208.044	8207.841	8207.644	8207.879
SX02	1432.485	1432.523	1432.285	1432.193
SX03	-18.029	-18.029	-18.029	-18.029
SX04	-1467.57	-1467.01	-1466.49	-1466.4
SX05	-4505.26	-4506.34	-4505.3	-4505.54
SX06	-3644.75	-3644.18	-3643.66	-3643.57
SX07	-17.973	-17.973	-17.973	-17.973
SX08	4462.123	4462.162	4461.923	4461.831

Wind Speed Analysis - Operating Condition

Fy

Load Comb.	Forces (kN)			
	16	18	20	22
OP01	9.299	9.299	9.299	9.299
OP02	2581.927	2584.167	2586.71	2589.562
OP03	3783.886	3788.366	3793.454	3799.158
OP04	2510.262	2512.502	2515.046	2517.898
OP05	-12.228	-12.228	-12.228	-12.228
OP06	-2517.35	-2519.59	-2522.14	-2524.99
OP07	-3778.23	-3782.71	-3787.8	-3793.5
OP08	-2557.72	-2559.96	-2562.51	-2565.36
ST01	9.834	9.834	9.834	9.834
ST02	1299.971	1299.869	1299.714	1299.655
ST03	1624.999	1624.577	1624.484	1624.693
ST04	1282.767	1282.665	1282.51	1282.451
ST05	-12.595	-12.595	-12.595	-12.595
ST06	-3253.98	-3253.41	-3253.03	-3252.97
ST07	-4856.72	-4857.29	-4856.55	-4856.76
ST08	-4021.19	-4020.62	-4020.25	-4020.19
SX01	9.834	9.834	9.834	9.834
SX02	1299.971	1299.869	1299.714	1299.655
SX03	1624.999	1624.577	1624.484	1624.693
SX04	1282.767	1282.665	1282.51	1282.451
SX05	-12.595	-12.595	-12.595	-12.595
SX06	-3253.98	-3253.41	-3253.03	-3252.97
SX07	-4856.72	-4857.29	-4856.55	-4856.76
SX08	-4021.19	-4020.62	-4020.25	-4020.19

Wind Speed Analysis - Operating Condition

Fz

Load Comb.	Forces (kN)			
	16	18	20	22
OP01	-18894.8	-18894.8	-18894.8	-18894.8
OP02	-18918.1	-18918.1	-18918.1	-18918.1
OP03	-18949.7	-18949.7	-18949.7	-18949.7
OP04	-19024.4	-19024.4	-19024.4	-19024.4
OP05	-19043	-19043	-19043	-19043
OP06	-19028.5	-19028.5	-19028.5	-19028.5
OP07	-18963.9	-18963.9	-18963.9	-18963.9
OP08	-18921.5	-18921.5	-18921.5	-18921.5
ST01	-18786.7	-18786.7	-18786.7	-18786.7
ST02	-18915.5	-18915.5	-18915.5	-18915.5
ST03	-18915.2	-18915.2	-18915.2	-18915.2
ST04	-18968.3	-18968.3	-18968.3	-18968.3
ST05	-19051.4	-19051.4	-19051.4	-19051.4
ST06	-19027.8	-19027.8	-19027.8	-19027.8
ST07	-18879.5	-18879.5	-18879.5	-18879.5
ST08	-18905.7	-18905.7	-18905.7	-18905.7
SX01	-17249.7	-17249.7	-17249.7	-17249.7
SX02	-17378.5	-17378.5	-17378.5	-17378.5
SX03	-17378.2	-17378.2	-17378.2	-17378.2
SX04	-17431.3	-17431.3	-17431.3	-17431.3
SX05	-17514.4	-17514.4	-17514.4	-17514.4
SX06	-17490.8	-17490.8	-17490.8	-17490.8
SX07	-17342.5	-17342.5	-17342.5	-17342.5
SX08	-17368.7	-17368.7	-17368.7	-17368.7

Wind Speed Analysis - Operating Condition

Joint Unity Check

Joint Number	Wind Speed (m/s)			
	16	18	20	22
2210	0.812	0.812	0.812	0.812
1190	0.804	0.804	0.805	0.807
2230	0.754	0.754	0.754	0.754
1199	0.708	0.708	0.708	0.708
3325	0.692	0.693	0.693	0.693
2220	0.669	0.669	0.669	0.669
2100	0.587	0.587	0.587	0.587
2300	0.565	0.565	0.565	0.565
3326	0.534	0.534	0.534	0.534
2400	0.47	0.47	0.471	0.471

Wind Speed Analysis - Operating Condition

Topside Lateral Displacement

Lateral Displacement- 7407

Wind Speed (m/s)	16	18	20	22
OP01	11.297	11.333	11.374	11.420
OP02	11.189	11.211	11.236	11.265
OP03	10.965	10.984	11.007	11.033
OP04	14.910	14.934	14.961	14.991
OP05	15.321	15.360	15.403	15.451
OP06	14.675	14.699	14.726	14.756
OP07	10.978	10.998	11.021	11.047
OP08	11.403	11.425	11.450	11.478

Wind Speed (m/s)	16	18	20	22
ST01	31.321	31.319	31.317	31.319
ST02	5.130	5.129	5.128	5.127
ST03	5.279	5.278	5.277	5.278
ST04	8.420	8.416	8.413	8.412
ST05	20.408	20.416	20.408	20.410
ST06	21.119	21.113	21.108	21.107
ST07	15.637	15.640	15.636	15.637
ST08	21.892	21.890	21.886	21.886

Wind Speed (m/s)	16	18	20	22
SX01	31.327	31.325	31.323	31.325
SX02	5.247	5.247	5.246	5.245
SX03	5.228	5.226	5.226	5.227
SX04	8.257	8.253	8.250	8.249
SX05	20.104	20.111	20.104	20.105
SX06	20.811	20.805	20.800	20.799
SX07	15.501	15.504	15.500	15.501
SX08	21.983	21.980	21.977	21.976

Wind Speed Analysis - Operating Condition

Lateral Displacement- 7417

Wind Speed (m/s)	16	18	20	22
OP01	11.279	11.316	11.356	11.402
OP02	11.044	11.066	11.092	11.120
OP03	10.545	10.565	10.589	10.616
OP04	14.741	14.765	14.792	14.822
OP05	15.335	15.373	15.416	15.465
OP06	14.507	14.531	14.558	14.588
OP07	10.438	10.459	10.483	10.510
OP08	11.105	11.127	11.152	11.180

Wind Speed (m/s)	16	18	20	22
ST01	31.300	31.298	31.297	31.299
ST02	5.081	5.081	5.079	5.079
ST03	5.160	5.158	5.157	5.158
ST04	8.361	8.358	8.355	8.354
ST05	20.421	20.428	20.421	20.423
ST06	20.904	20.898	20.893	20.892
ST07	14.879	14.882	14.878	14.879
ST08	21.405	21.403	21.399	21.399

Wind Speed (m/s)	16	18	20	22
SX01	31.310	31.308	31.307	31.309
SX02	5.197	5.197	5.195	5.194
SX03	5.099	5.098	5.097	5.098
SX04	8.191	8.187	8.184	8.184
SX05	20.113	20.120	20.113	20.115
SX06	20.599	20.593	20.588	20.587
SX07	14.749	14.752	14.748	14.750
SX08	21.503	21.501	21.497	21.497

Wind Speed Analysis - Operating Condition

Lateral Displacement- 7534

Wind Speed (m/s)	16	18	20	22
OP01	11.185	11.221	11.262	11.307
OP02	11.315	11.337	11.362	11.390
OP03	10.901	10.920	10.943	10.969
OP04	14.658	14.682	14.709	14.740
OP05	15.290	15.329	15.372	15.421
OP06	14.908	14.931	14.958	14.988
OP07	11.058	11.079	11.101	11.127
OP08	11.148	11.170	11.195	11.223

Wind Speed (m/s)	16	18	20	22
ST01	31.117	31.115	31.114	31.116
ST02	5.160	5.160	5.158	5.158
ST03	5.237	5.235	5.235	5.236
ST04	8.300	8.297	8.293	8.293
ST05	20.318	20.325	20.318	20.320
ST06	21.391	21.385	21.380	21.379
ST07	15.725	15.728	15.724	15.725
ST08	21.432	21.429	21.426	21.425

Wind Speed (m/s)	16	18	20	22
SX01	31.126	31.125	31.123	31.125
SX02	5.281	5.281	5.279	5.279
SX03	5.188	5.186	5.185	5.186
SX04	8.135	8.132	8.129	8.128
SX05	20.010	20.017	20.010	20.012
SX06	21.077	21.071	21.066	21.065
SX07	15.582	15.585	15.581	15.582
SX08	21.520	21.518	21.515	21.514

Wind Speed Analysis - Operating Condition

Lateral Displacement- 7541

Wind Speed (m/s)	16	18	20	22
OP01	11.182	11.219	11.259	11.305
OP02	11.170	11.193	11.218	11.246
OP03	10.455	10.476	10.499	10.526
OP04	14.467	14.491	14.518	14.549
OP05	15.296	15.335	15.378	15.426
OP06	14.745	14.769	14.795	14.825
OP07	10.540	10.560	10.584	10.611
OP08	10.866	10.888	10.913	10.942

Wind Speed (m/s)	16	18	20	22
ST01	31.117	31.116	31.114	31.116
ST02	5.107	5.107	5.105	5.105
ST03	5.092	5.090	5.090	5.091
ST04	8.222	8.219	8.216	8.215
ST05	20.325	20.333	20.326	20.327
ST06	21.183	21.177	21.172	21.172
ST07	14.988	14.991	14.987	14.988
ST08	20.959	20.957	20.954	20.953

Wind Speed (m/s)	16	18	20	22
SX01	31.128	31.126	31.125	31.127
SX02	5.227	5.227	5.226	5.225
SX03	5.039	5.037	5.037	5.037
SX04	8.054	8.051	8.048	8.047
SX05	20.016	20.024	20.016	20.018
SX06	20.871	20.865	20.861	20.860
SX07	14.847	14.850	14.846	14.847
SX08	21.051	21.049	21.045	21.044

WIND SPEED – STORM

Wind Speed Analysis - Storm Condition

Load Case Summary

wind speed (m/s)	Load (kN)	
	X-dir	Y- dir
36	24.96	19.44
40	24.96	19.44
44	24.96	19.44
48	24.96	19.44

Wind Speed Analysis - Storm Condition

Load Combination

Fx

Load Comb.	Forces (kN)			
	36	40	44	48
OP01	3645.361	3645.361	3645.361	3645.361
OP02	2860.557	2860.557	2860.557	2860.557
OP03	-16.675	-16.675	-16.675	-16.675
OP04	-2843.05	-2843.05	-2843.05	-2843.05
OP05	-3578.03	-3578.03	-3578.03	-3578.03
OP06	-2832.26	-2832.26	-2832.26	-2832.26
OP07	-2.673	-2.673	-2.673	-2.673
OP08	2850.879	2850.879	2850.879	2850.879
ST01	8219.702	8246.159	8275.113	8306.812
ST02	1438.314	1451.542	1466.019	1481.869
ST03	-18.029	-18.029	-18.029	-18.029
ST04	-1472.52	-1485.75	-1500.22	-1516.07
ST05	-4517.36	-4543.82	-4572.77	-4604.47
ST06	-3649.69	-3662.92	-3677.4	-3693.24
ST07	-17.973	-17.973	-17.973	-17.973
ST08	4467.952	4481.181	4495.658	4511.507
SX01	8219.702	8246.159	8275.113	8306.812
SX02	1438.314	1451.542	1466.019	1481.869
SX03	-18.029	-18.029	-18.029	-18.029
SX04	-1472.52	-1485.75	-1500.22	-1516.07
SX05	-4517.36	-4543.82	-4572.77	-4604.47
SX06	-3649.69	-3662.92	-3677.4	-3693.24
SX07	-17.973	-17.973	-17.973	-17.973
SX08	4467.952	4481.181	4495.658	4511.507

Wind Speed Analysis - Storm Condition

Fy

Load Comb.	Forces (kN)			
	36	40	44	48
OP01	9.299	9.299	9.299	9.299
OP02	2583.006	2583.006	2583.006	2583.006
OP03	3786.046	3786.046	3786.046	3786.046
OP04	2511.343	2511.343	2511.343	2511.343
OP05	-12.228	-12.228	-12.228	-12.228
OP06	-2518.43	-2518.43	-2518.43	-2518.43
OP07	-3780.39	-3780.39	-3780.39	-3780.39
OP08	-2558.8	-2558.8	-2558.8	-2558.8
ST01	9.834	9.834	9.834	9.834
ST02	1304.464	1314.767	1326.042	1338.387
ST03	1633.985	1654.591	1677.142	1701.83
ST04	1287.26	1297.563	1308.838	1321.183
ST05	-12.595	-12.595	-12.595	-12.595
ST06	-3257.78	-3268.09	-3279.36	-3291.71
ST07	-4866.05	-4886.65	-4909.2	-4933.89
ST08	-4025	-4035.3	-4046.57	-4058.92
SX01	9.834	9.834	9.834	9.834
SX02	1304.464	1314.767	1326.042	1338.386
SX03	1633.985	1654.591	1677.141	1701.83
SX04	1287.26	1297.563	1308.838	1321.183
SX05	-12.595	-12.595	-12.595	-12.595
SX06	-3257.78	-3268.09	-3279.36	-3291.71
SX07	-4866.05	-4886.65	-4909.2	-4933.89
SX08	-4025	-4035.3	-4046.57	-4058.92

Wind Speed Analysis - Storm Condition

Fz

Load Comb.	Forces (kN)			
	36	40	44	48
OP01	-18894.8	-18894.8	-18894.8	-18894.8
OP02	-18918.1	-18918.1	-18918.1	-18918.1
OP03	-18949.7	-18949.7	-18949.7	-18949.7
OP04	-19024.4	-19024.4	-19024.4	-19024.4
OP05	-19043	-19043	-19043	-19043
OP06	-19028.5	-19028.5	-19028.5	-19028.5
OP07	-18963.9	-18963.9	-18963.9	-18963.9
OP08	-18921.5	-18921.5	-18921.5	-18921.5
ST01	-18786.7	-18786.7	-18786.7	-18786.7
ST02	-18915.5	-18915.5	-18915.5	-18915.5
ST03	-18915.2	-18915.2	-18915.2	-18915.2
ST04	-18968.3	-18968.3	-18968.3	-18968.3
ST05	-19051.4	-19051.4	-19051.4	-19051.4
ST06	-19027.8	-19027.8	-19027.8	-19027.8
ST07	-18879.5	-18879.5	-18879.5	-18879.5
ST08	-18905.7	-18905.7	-18905.7	-18905.7
SX01	-17249.7	-17249.7	-17249.7	-17249.7
SX02	-17378.5	-17378.5	-17378.5	-17378.5
SX03	-17378.2	-17378.2	-17378.2	-17378.2
SX04	-17431.3	-17431.3	-17431.3	-17431.3
SX05	-17514.4	-17514.4	-17514.4	-17514.4
SX06	-17490.8	-17490.8	-17490.8	-17490.8
SX07	-17342.5	-17342.5	-17342.5	-17342.5
SX08	-17368.7	-17368.7	-17368.7	-17368.7

Wind Speed Analysis - Storm Condition

Joint Unity Check

Joint Number	Wind Speed (m/s)			
	36	40	44	48
2210	0.812	0.812	0.812	0.812
1190	0.804	0.804	0.804	0.804
2230	0.754	0.754	0.753	0.758
1199	0.708	0.708	0.708	0.708
3325	0.692	0.692	0.692	0.692
2220	0.669	0.669	0.669	0.669
2100	0.588	0.59	0.592	0.597
2300	0.565	0.567	0.57	0.572
3326	0.534	0.534	0.534	0.534
2400	0.47	0.47	0.47	0.47

Wind Speed Analysis - Storm Condition

Topside Lateral Displacement

Lateral Displacement- 7407

Wind Speed (m/s)	36	40	44	48
OP01	11.31449	11.31449	11.31449	11.31449
OP02	11.19991	11.19991	11.19991	11.19991
OP03	10.97399	10.97399	10.97399	10.97399
OP04	14.92188	14.92188	14.92188	14.92188
OP05	15.33941	15.33941	15.33941	15.33941
OP06	14.68608	14.68608	14.68608	14.68608
OP07	10.9873	10.9873	10.9873	10.9873
OP08	11.41395	11.41395	11.41395	11.41395
Wind Speed (m/s)				
ST01	31.42865	31.67555	31.94843	32.25122
ST02	5.16914	5.259442	5.358308	5.466825
ST03	5.318671	5.408936	5.507941	5.616901
ST04	8.457317	8.554175	8.660308	8.776569
ST05	20.49298	20.67878	20.88257	21.10647
ST06	21.16655	21.29555	21.43703	21.59259
ST07	15.68564	15.79397	15.91278	16.04296
ST08	21.94518	22.07418	22.21792	22.38275
Wind Speed (m/s)				
SX01	31.42553	31.65132	31.91429	32.20997
SX02	5.286896	5.377231	5.476362	5.584878
SX03	5.26757	5.358563	5.458229	5.567784
SX04	8.294136	8.390658	8.496415	8.612178
SX05	20.18753	20.37163	20.57353	20.79533
SX06	20.85862	20.98649	21.12681	21.28088
SX07	15.54969	15.6573	15.7753	15.90451
SX08	22.03625	22.16585	22.30836	22.46501

Wind Speed Analysis - Storm Condition

Lateral Displacement- 7417

Wind Speed (m/s)	36	40	44	48
OP01	11.2965	11.2965	11.2965	11.2965
OP02	11.05478	11.05478	11.05478	11.05478
OP03	10.55476	10.55476	10.55476	10.55476
OP04	14.75257	14.75257	14.75257	14.75257
OP05	15.35311	15.35311	15.35311	15.35311
OP06	14.51821	14.51821	14.51821	14.51821
OP07	10.44816	10.44816	10.44816	10.44816
OP08	11.11525	11.11525	11.11525	11.11525
Wind Speed (m/s)				
ST01	31.40811	31.65491	31.92771	32.23041
ST02	5.121181	5.21287	5.313263	5.423438
ST03	5.200037	5.29293	5.39503	5.507146
ST04	8.398967	8.496313	8.602881	8.719658
ST05	20.50575	20.69135	20.89505	21.11885
ST06	20.95207	21.08189	21.22421	21.38075
ST07	14.92937	15.04099	15.16349	15.29767
ST08	21.45888	21.58896	21.73414	21.90052
Wind Speed (m/s)				
SX01	31.4088	31.6345	31.89741	32.19301
SX02	5.236989	5.328709	5.429292	5.539466
SX03	5.140272	5.233898	5.336667	5.449517
SX04	8.228416	8.325459	8.431734	8.548095
SX05	20.1966	20.3806	20.5824	20.8041
SX06	20.64647	20.77518	20.91636	21.07147
SX07	14.79949	14.91043	15.03205	15.16536
SX08	21.55708	21.68788	21.83167	21.98966

Wind Speed Analysis - Storm Condition

Lateral Displacement- 7534

Wind Speed (m/s)	36	40	44	48
OP01	11.20203	11.20203	11.20203	11.20203
OP02	11.32589	11.32589	11.32589	11.32589
OP03	10.91023	10.91023	10.91023	10.91023
OP04	14.66997	14.66997	14.66997	14.66997
OP05	15.3089	15.3089	15.3089	15.3089
OP06	14.91903	14.91903	14.91903	14.91903
OP07	11.06807	11.06807	11.06807	11.06807
OP08	11.1586	11.1586	11.1586	11.1586
Wind Speed (m/s)				
ST01	31.22508	31.47147	31.74396	32.04615
ST02	5.199266	5.288449	5.386268	5.49352
ST03	5.27685	5.368581	5.469288	5.579794
ST04	8.338058	8.435906	8.543031	8.660511
ST05	20.40247	20.58777	20.79107	21.01447
ST06	21.43838	21.56611	21.70626	21.86021
ST07	15.77318	15.88065	15.99845	16.12765
ST08	21.48551	21.61524	21.75987	21.92571
Wind Speed (m/s)				
SX01	31.22526	31.45054	31.71291	32.0081
SX02	5.320101	5.409435	5.507351	5.614577
SX03	5.227888	5.320182	5.421406	5.532518
SX04	8.173486	8.271072	8.377853	8.49482
SX05	20.09363	20.27722	20.47862	20.69982
SX06	21.12374	21.25032	21.38921	21.54174
SX07	15.62995	15.73669	15.85366	15.98195
SX08	21.57421	21.70472	21.84791	22.00552

Wind Speed Analysis - Storm Condition

Lateral Displacement- 7541

Wind Speed (m/s)	36	40	44	48
OP01	11.19952	11.19952	11.19952	11.19952
OP02	11.18087	11.18087	11.18087	11.18087
OP03	10.4649	10.4649	10.4649	10.4649
OP04	14.47874	14.47874	14.47874	14.47874
OP05	15.31474	15.31474	15.31474	15.31474
OP06	14.75614	14.75614	14.75614	14.75614
OP07	10.54967	10.54967	10.54967	10.54967
OP08	10.87643	10.87643	10.87643	10.87643
Wind Speed (m/s)				
ST01	31.22534	31.47204	31.74484	32.04744
ST02	5.146969	5.237761	5.337331	5.446476
ST03	5.133423	5.22793	5.331721	5.445666
ST04	8.26092	8.359357	8.467331	8.585517
ST05	20.41011	20.59581	20.79941	21.02321
ST06	21.23109	21.35971	21.50081	21.65596
ST07	15.03774	15.14842	15.26971	15.40279
ST08	21.01381	21.14505	21.29146	21.45915
Wind Speed (m/s)				
SX01	31.2269	31.4525	31.7153	32.0108
SX02	5.267242	5.358157	5.457796	5.566953
SX03	5.080301	5.175522	5.279865	5.39448
SX04	8.092625	8.19093	8.298425	8.416321
SX05	20.10002	20.28392	20.48582	20.70742
SX06	20.91883	21.04631	21.18627	21.33987
SX07	14.89669	15.00667	15.12728	15.25958
SX08	21.10553	21.23744	21.38232	21.54169

APPENDIX C.4: Spreadsheet on Wave Height Analysis

WAVE HEIGHT – OPERATING

Wave Height Analysis - Operating Condition

Load Case Summary

Load Label	Wave Height (m)			
	6	6.5	7	7.5
101	3127.843	3414.778	3719.146	4053.191
102	2461.077	2687.07	2933.931	3185.491
103	-14.044	-26.007	-25.74	-24.148
104	-2443.99	-2673.2	-2916.39	-3162.42
105	-3041.14	-3350.49	-3676.12	-3995.64
106	-2434.23	-2667.46	-2905.09	-3148.52
107	-2.228	-11.338	-9.319	-6.724
108	2451.441	2677.914	2922.599	3174.266
111	7291.26	7291.26	7291.26	7291.26
112	1186.612	1186.612	1186.612	1186.612
113	-15.475	-15.475	-15.475	-15.475
114	-1215.97	-1215.97	-1215.97	-1215.97
115	-3961.82	-3961.82	-3961.82	-3961.82
116	-3252.29	-3252.29	-3252.29	-3252.29
117	-16.265	-16.265	-16.265	-16.265
118	3992.798	3992.798	3992.798	3992.798

Load Label	Wave Height (m)			
	6	6.5	7	7.5
101	-39.467	8.94	18.955	-22.559
102	-19.013	-12.093	-1.693	10.793
103	-46.621	-132.826	-78.564	-7.804
104	-109.363	-111.981	-105.909	-99.441
105	-92.488	-130.511	-124.084	-119.52
106	-113.6	-116.757	-111.351	-105.597
107	-58.983	-144.703	-92.323	-23.468
108	-22.064	-15.358	-6.082	7.213
111	99.188	99.188	99.188	99.188
112	-15.928	-15.928	-15.928	-15.928
113	-15.651	-15.651	-15.651	-15.651
114	-61.212	-61.212	-61.212	-61.212
115	-138.85	-138.85	-138.85	-138.85
116	-118.377	-118.377	-118.377	-118.377
117	15.776	15.776	15.776	15.776
118	-7.859	-7.859	-7.859	-7.859

Wave Height Analysis - Operating Condition

FY

Load Label	Wave Height (m)			
	6	6.5	7	7.5
101	8.247	8.355	8.56	11.166
102	2217.571	2433.53	2656.58	2882.353
103	3249.025	3563.317	3934.449	4281.351
104	2158.78	2364.998	2584.217	2803.877
105	-10.814	-11.874	-13.297	-14.545
106	-2165.18	-2375.01	-2591.49	-2811.12
107	-3244.08	-3557.48	-3927.83	-4272.25
108	-2197.02	-2409.07	-2627.16	-2852.07
111	8.842	8.842	8.842	8.842
112	1082.332	1082.332	1082.332	1082.332
113	1327.804	1327.804	1327.804	1327.804
114	1067.564	1067.564	1067.564	1067.564
115	-11.328	-11.328	-11.328	-11.328
116	-2908.81	-2908.81	-2908.81	-2908.81
117	-4324.85	-4324.85	-4324.85	-4324.85
118	-3603.12	-3603.12	-3603.12	-3603.12

Wave Height Analysis - Operating Condition

Load Combination
Fx

Load Comb.	Description	Forces (kN)			
		6	6.5	7	7.5
OP01	Operating v	3583.275	3884.556	4204.142	4554.889
OP02	Operating v	2812.222	3049.515	3308.719	3572.857
OP03	Operating v	-16.009	-28.57	-28.29	-26.618
OP04	Operating v	-2792.95	-3033.62	-3288.98	-3547.3
OP05	Operating v	-3487.13	-3811.95	-4153.87	-4489.36
OP06	Operating v	-2781.89	-3026.79	-3276.3	-3531.9
OP07	Operating v	-2.542	-12.107	-9.987	-7.263
OP08	Operating v	2801.372	3039.168	3296.087	3560.337
ST01	Storm max	8207.721	8207.721	8207.721	8207.721
ST02	Storm max	1432.323	1432.323	1432.323	1432.323
ST03	Storm max	-18.029	-18.029	-18.029	-18.029
ST04	Storm max	-1466.53	-1466.53	-1466.53	-1466.53
ST05	Storm max	-4505.38	-4505.38	-4505.38	-4505.38
ST06	Storm max	-3643.7	-3643.7	-3643.7	-3643.7
ST07	Storm max	-17.973	-17.973	-17.973	-17.973
ST08	Storm max	4461.961	4461.961	4461.961	4461.961
SX01	Storm mini	8207.721	8207.721	8207.721	8207.721
SX02	Storm mini	1432.323	1432.323	1432.323	1432.323
SX03	Storm mini	-18.029	-18.029	-18.029	-18.029
SX04	Storm mini	-1466.53	-1466.53	-1466.53	-1466.53
SX05	Storm mini	-4505.38	-4505.38	-4505.38	-4505.38
SX06	Storm mini	-3643.7	-3643.7	-3643.7	-3643.7
SX07	Storm mini	-17.973	-17.973	-17.973	-17.973
SX08	Storm mini	4461.961	4461.961	4461.961	4461.961

Wave Height Analysis - Operating Condition

Fy

Load Comb.	Description	Forces (kN)			
		6	6.5	7	7.5
OP01	Operating v	9.365	9.479	9.693	12.43
OP02	Operating v	2532.98	2759.737	2993.939	3231.001
OP03	Operating v	3716.066	4046.072	4435.761	4800.008
OP04	Operating v	2465.824	2682.353	2912.532	3143.176
OP05	Operating v	-12.279	-13.392	-14.886	-16.196
OP06	Operating v	-2473.08	-2693.4	-2920.7	-3151.32
OP07	Operating v	-3710.44	-4039.51	-4428.38	-4790.02
OP08	Operating v	-2509.56	-2732.21	-2961.21	-3197.37
ST01	Storm max	9.834	9.834	9.834	9.834
ST02	Storm max	1299.798	1299.798	1299.798	1299.798
ST03	Storm max	1624.654	1624.654	1624.654	1624.654
ST04	Storm max	1282.594	1282.594	1282.594	1282.594
ST05	Storm max	-12.595	-12.595	-12.595	-12.595
ST06	Storm max	-3253.12	-3253.12	-3253.12	-3253.12
ST07	Storm max	-4856.72	-4856.72	-4856.72	-4856.72
ST08	Storm max	-4020.33	-4020.33	-4020.33	-4020.33
SX01	Storm mini	9.834	9.834	9.834	9.834
SX02	Storm mini	1299.798	1299.798	1299.798	1299.798
SX03	Storm mini	1624.653	1624.653	1624.653	1624.653
SX04	Storm mini	1282.594	1282.594	1282.594	1282.594
SX05	Storm mini	-12.595	-12.595	-12.595	-12.595
SX06	Storm mini	-3253.12	-3253.12	-3253.12	-3253.12
SX07	Storm mini	-4856.72	-4856.72	-4856.72	-4856.72
SX08	Storm mini	-4020.33	-4020.33	-4020.33	-4020.33

Wave Height Analysis - Operating Condition

Fz

Load Comb.	Description	Forces (kN)			
		6	6.5	7	7.5
OP01	Operating V	-18938.2	-18887.4	-18876.9	-18920.5
OP02	Operating V	-18918.5	-18911.3	-18900.4	-18887.2
OP03	Operating V	-18949.9	-19040.4	-18983.5	-18909.2
OP04	Operating V	-19021.4	-19024.2	-19017.8	-19011
OP05	Operating V	-19005.1	-19045.1	-19038.3	-19033.5
OP06	Operating V	-19026.2	-19029.5	-19023.9	-19017.8
OP07	Operating V	-18964	-19054	-18999	-18926.7
OP08	Operating V	-18922	-18915	-18905.2	-18891.3
ST01	Storm max	-18786.7	-18786.7	-18786.7	-18786.7
ST02	Storm max	-18915.5	-18915.5	-18915.5	-18915.5
ST03	Storm max	-18915.2	-18915.2	-18915.2	-18915.2
ST04	Storm max	-18968.3	-18968.3	-18968.3	-18968.3
ST05	Storm max	-19051.4	-19051.4	-19051.4	-19051.4
ST06	Storm max	-19027.8	-19027.8	-19027.8	-19027.8
ST07	Storm max	-18879.5	-18879.5	-18879.5	-18879.5
ST08	Storm max	-18905.7	-18905.7	-18905.7	-18905.7
SX01	Storm mini	-17249.7	-17249.7	-17249.7	-17249.7
SX02	Storm mini	-17378.5	-17378.5	-17378.5	-17378.5
SX03	Storm mini	-17378.2	-17378.2	-17378.2	-17378.2
SX04	Storm mini	-17431.3	-17431.3	-17431.3	-17431.3
SX05	Storm mini	-17514.4	-17514.4	-17514.4	-17514.4
SX06	Storm mini	-17490.8	-17490.8	-17490.8	-17490.8
SX07	Storm mini	-17342.5	-17342.5	-17342.5	-17342.5
SX08	Storm mini	-17368.7	-17368.7	-17368.7	-17368.7

Wave Height Analysis - Operating Condition

Joint Unity Check

Joint Number	Wave Height (m)			
	6	6.5	7	7.5
2210	0.8	0.861	0.937	1.025
1190	0.786	0.848	0.859	0.857
2230	0.754	0.765	0.818	0.87
1199	0.703	0.737	0.733	0.763
3325	0.681	0.703	0.828	0.947
2220	0.669	0.669	0.697	0.73
2100	0.587	0.587	0.587	0.587
7179	0.585	0.583	0.583	0.583
2300	0.565	0.565	0.581	0.623
3326	0.529	0.555	0.59	0.628
2400	0.47	0.47	0.554	0.601

Wave Height Analysis - Operating Condition

Topside Lateral Displacement

Lateral Displacement- 7407

Wave Height (m)	6	6.5	7	7.5
OP01	11.06241	12.38171	13.80647	15.4374
OP02	10.90977	12.29476	13.8025	15.39539
OP03	10.69385	11.94628	13.28019	14.54467
OP04	14.60639	16.13409	17.81968	19.58483
OP05	14.848	16.44961	18.09082	19.72873
OP06	14.37789	15.89916	17.50686	19.21927
OP07	10.71718	11.95832	13.28313	14.53025
OP08	11.11569	12.51281	14.02244	15.63846
ST01	31.31776	31.31776	31.31776	31.31776
ST02	5.128392	5.128392	5.128392	5.128392
ST03	5.277829	5.277829	5.277829	5.277829
ST04	8.413412	8.413412	8.413412	8.413412
ST05	20.40898	20.40898	20.40898	20.40898
ST06	21.10818	21.10818	21.10818	21.10818
ST07	15.63657	15.63657	15.63657	15.63657
ST08	21.88693	21.88693	21.88693	21.88693
SX01	31.32384	31.32384	31.32384	31.32384
SX02	5.246037	5.246037	5.246037	5.246037
SX03	5.226523	5.226523	5.226523	5.226523
SX04	8.250405	8.250405	8.250405	8.250405
SX05	20.10434	20.10434	20.10434	20.10434
SX06	20.8008	20.8008	20.8008	20.8008
SX07	15.50097	15.50097	15.50097	15.50097
SX08	21.9777	21.9777	21.9777	21.9777

Wave Height Analysis - Operating Condition

Lateral Displacement- 7417

Wave Height (m)	6	6.5	7	7.5
OP01	11.0444	12.3636	13.78811	15.41882
OP02	10.76839	12.14282	13.64418	15.22214
OP03	10.29374	11.46916	12.74471	13.95795
OP04	14.44372	15.9389	17.58848	19.31984
OP05	14.8618	16.46322	18.10423	19.74195
OP06	14.21465	15.71587	17.30245	18.99459
OP07	10.19678	11.37209	12.63262	13.82186
OP08	10.82276	12.19704	13.67749	15.26304
ST01	31.29721	31.29721	31.29721	31.29721
ST02	5.079739	5.079739	5.079739	5.079739
ST03	5.158105	5.158105	5.158105	5.158105
ST04	8.354924	8.354924	8.354924	8.354924
ST05	20.42175	20.42175	20.42175	20.42175
ST06	20.89336	20.89336	20.89336	20.89336
ST07	14.87885	14.87885	14.87885	14.87885
ST08	21.40011	21.40011	21.40011	21.40011
SX01	31.3072	31.3072	31.3072	31.3072
SX02	5.195508	5.195508	5.195508	5.195508
SX03	5.097903	5.097903	5.097903	5.097903
SX04	8.18453	8.18453	8.18453	8.18453
SX05	20.1135	20.1135	20.1135	20.1135
SX06	20.58833	20.58833	20.58833	20.58833
SX07	14.74922	14.74922	14.74922	14.74922
SX08	21.49801	21.49801	21.49801	21.49801

Wave Height Analysis - Operating Condition

Lateral Displacement- 7534

Wave Height (m)	6	6.5	7	7.5
OP01	10.94915	12.25844	13.6678	15.28663
OP02	11.03213	12.42844	13.94421	15.55314
OP03	10.63007	11.87413	13.20696	14.47147
OP04	14.36215	15.85205	17.49658	19.22409
OP05	14.8233	16.40871	18.03572	19.65793
OP06	14.60567	16.14821	17.7777	19.51081
OP07	10.79808	12.04488	13.37047	14.61773
OP08	10.86623	12.23809	13.71496	15.29687
ST01	31.11429	31.11429	31.11429	31.11429
ST02	5.158866	5.158866	5.158866	5.158866
ST03	5.235333	5.235333	5.235333	5.235333
ST04	8.293771	8.293771	8.293771	8.293771
ST05	20.31867	20.31867	20.31867	20.31867
ST06	21.38066	21.38066	21.38066	21.38066
ST07	15.72459	15.72459	15.72459	15.72459
ST08	21.42695	21.42695	21.42695	21.42695
SX01	31.12376	31.12376	31.12376	31.12376
SX02	5.279674	5.279674	5.279674	5.279674
SX03	5.186158	5.186158	5.186158	5.186158
SX04	8.129378	8.129378	8.129378	8.129378
SX05	20.01053	20.01053	20.01053	20.01053
SX06	21.06652	21.06652	21.06652	21.06652
SX07	15.58159	15.58159	15.58159	15.58159
SX08	21.51541	21.51541	21.51541	21.51541

Wave Height Analysis - Operating Condition

Lateral Displacement- 7541

Wave Height (m)	6	6.5	7	7.5
OP01	10.94662	12.25611	13.6656	15.2848
OP02	10.89086	12.27693	13.78676	15.38135
OP03	10.20387	11.37024	12.64467	13.85777
OP04	14.17765	15.6344	17.24225	18.93535
OP05	14.82894	16.41466	18.04198	19.66441
OP06	14.44738	15.97048	17.57967	19.2931
OP07	10.29837	11.47952	12.74105	13.93031
OP08	10.58994	11.93863	13.38577	14.93667
ST01	31.11444	31.11444	31.11444	31.11444
ST02	5.10584	5.10584	5.10584	5.10584
ST03	5.090706	5.090706	5.090706	5.090706
ST04	8.216311	8.216311	8.216311	8.216311
ST05	20.32611	20.32611	20.32611	20.32611
ST06	21.173	21.173	21.173	21.173
ST07	14.98763	14.98763	14.98763	14.98763
ST08	20.95462	20.95462	20.95462	20.95462
SX01	31.1252	31.1252	31.1252	31.1252
SX02	5.22617	5.22617	5.22617	5.22617
SX03	5.037292	5.037292	5.037292	5.037292
SX04	8.048176	8.048176	8.048176	8.048176
SX05	20.01682	20.01682	20.01682	20.01682
SX06	20.86115	20.86115	20.86115	20.86115
SX07	14.8469	14.8469	14.8469	14.8469
SX08	21.04604	21.04604	21.04604	21.04604

WAVE HEIGHT – STORM

Wave Height Analysis - Storm Condition

Load Case Summary

Load Label	Wave Height (m)			
	11	11.5	12	12.5
101	3186.973	3186.973	3186.973	3186.973
102	2507.11	2507.11	2507.11	2507.11
103	-14.679	-14.679	-14.679	-14.679
104	-2491.7	-2491.7	-2491.7	-2491.7
105	-3127.7	-3127.7	-3127.7	-3127.7
106	-2482.2	-2482.2	-2482.2	-2482.2
107	-2.353	-2.353	-2.353	-2.353
108	2498.591	2498.591	2498.591	2498.591
111	7945.354	8338.749	8766.971	9217.763
112	3476.752	3760.812	4043.395	4340.274
113	-41.771	-41.849	-49.254	-49.842
114	-3448.48	-3728.01	-3999.87	-4293.88
115	-4447.3	-4738.49	-5067.6	-5387.6
116	-2770.84	-2975.49	-3210.06	-3436.18
117	-16.624	-16.4	-16.325	-22.193
118	3490.179	3726.676	3959.621	4198.865

Load Label	Wave Height (m)			
	11	11.5	12	12.5
101	1.957	1.957	1.957	1.957
102	-18.594	-18.594	-18.594	-18.594
103	-46.432	-46.432	-46.432	-46.432
104	-112.139	-112.139	-112.139	-112.139
105	-128.572	-128.572	-128.572	-128.572
106	-115.811	-115.811	-115.811	-115.811
107	-58.882	-58.882	-58.882	-58.882
108	-21.625	-21.625	-21.625	-21.625
111	119.497	133.502	147.844	161.72
112	106.153	126.297	149.992	175.039
113	49.587	57.673	-71.653	-63.724
114	-106.693	-99.642	-92.274	-88.461
115	-137.348	-132.768	-128.134	-122.985
116	-130.385	-125.66	-119.62	-112.521
117	-10.575	0.946	13.464	-76.81
118	70.475	85.443	104.181	-0.466

Wave Height Analysis - Storm Condition

FY

Load Label	Wave Height (m)			
	11	11.5	12	12.5
101	8.184	8.184	8.184	8.184
102	2265.215	2265.215	2265.215	2265.215
103	3315.673	3315.673	3315.673	3315.673
104	2202.131	2202.131	2202.131	2202.131
105	-10.766	-10.766	-10.766	-10.766
106	-2208.38	-2208.38	-2208.38	-2208.38
107	-3310.7	-3310.7	-3310.7	-3310.7
108	-2243.91	-2243.91	-2243.91	-2243.91
111	11.055	11.755	11.085	11.565
112	3211.827	3470.548	3727.799	3997.358
113	4431.917	4836.903	5226.22	5646.645
114	3080.588	3335.536	3583.21	3848.39
115	-12.563	-15.253	-16.912	-18.802
116	-2467.62	-2656.16	-2869.95	-3077.22
117	-3684.72	-3953.76	-4273.44	-4587.99
118	-3139.56	-3352.69	-3565.91	-3792.17

Wave Height Analysis - Storm Condition

Load Combination

Fx

Load Comb.	Forces (kN)			
	11	11.5	12	12.5
OP01	3645.361	3645.361	3645.361	3645.361
OP02	2860.557	2860.557	2860.557	2860.557
OP03	-16.675	-16.675	-16.675	-16.675
OP04	-2843.05	-2843.05	-2843.05	-2843.05
OP05	-3578.03	-3578.03	-3578.03	-3578.03
OP06	-2832.26	-2832.26	-2832.26	-2832.26
OP07	-2.673	-2.673	-2.673	-2.673
OP08	2850.879	2850.879	2850.879	2850.879
ST01	8894.519	9307.584	9757.217	10230.55
ST02	3836.969	4135.232	4431.945	4743.667
ST03	-45.639	-45.721	-53.496	-54.114
ST04	-3810.66	-4104.17	-4389.62	-4698.33
ST05	-5015.14	-5320.88	-5666.45	-6002.45
ST06	-3138.18	-3353.06	-3599.36	-3836.78
ST07	-18.35	-18.114	-18.036	-24.198
ST08	3934.212	4182.534	4427.126	4678.332
SX01	8894.519	9307.584	9757.217	10230.55
SX02	3836.969	4135.232	4431.945	4743.667
SX03	-45.639	-45.721	-53.496	-54.114
SX04	-3810.66	-4104.17	-4389.62	-4698.33
SX05	-5015.14	-5320.88	-5666.45	-6002.45
SX06	-3138.18	-3353.06	-3599.36	-3836.78
SX07	-18.35	-18.114	-18.036	-24.198
SX08	3934.212	4182.534	4427.126	4678.332

Wave Height Analysis - Storm Condition

Fy

Load Comb.	Forces (kN)			
	11	11.5	12	12.5
OP01	9.299	9.299	9.299	9.299
OP02	2583.006	2583.006	2583.006	2583.006
OP03	3786.046	3786.046	3786.046	3786.046
OP04	2511.343	2511.343	2511.343	2511.343
OP05	-12.228	-12.228	-12.228	-12.228
OP06	-2518.43	-2518.43	-2518.43	-2518.43
OP07	-3780.39	-3780.39	-3780.39	-3780.39
OP08	-2558.8	-2558.8	-2558.8	-2558.8
ST01	12.158	12.893	12.19	12.693
ST02	3535.768	3807.425	4077.539	4360.576
ST03	4883.972	5309.207	5717.99	6159.436
ST04	3396.27	3663.965	3924.023	4202.461
ST05	-13.891	-16.716	-18.459	-20.442
ST06	-2789.87	-2987.83	-3212.31	-3429.95
ST07	-4184.58	-4467.07	-4802.74	-5133.01
ST08	-3533.59	-3757.37	-3981.25	-4218.82
SX01	12.158	12.893	12.19	12.693
SX02	3535.768	3807.425	4077.539	4360.576
SX03	4883.972	5309.207	5717.99	6159.436
SX04	3396.269	3663.965	3924.022	4202.461
SX05	-13.891	-16.716	-18.459	-20.442
SX06	-2789.87	-2987.83	-3212.31	-3429.95
SX07	-4184.58	-4467.07	-4802.74	-5133.01
SX08	-3533.59	-3757.37	-3981.25	-4218.82

Wave Height Analysis - Storm Condition

Fz

Load Comb.	Forces (kN)			
	11	11.5	12	12.5
OP01	-18894.8	-18894.8	-18894.8	-18894.8
OP02	-18918.1	-18918.1	-18918.1	-18918.1
OP03	-18949.7	-18949.7	-18949.7	-18949.7
OP04	-19024.4	-19024.4	-19024.4	-19024.4
OP05	-19043	-19043	-19043	-19043
OP06	-19028.5	-19028.5	-19028.5	-19028.5
OP07	-18963.9	-18963.9	-18963.9	-18963.9
OP08	-18921.5	-18921.5	-18921.5	-18921.5
ST01	-18765.4	-18750.6	-18735.6	-18721
ST02	-18787.3	-18766.2	-18741.3	-18715
ST03	-18846.7	-18838.2	-18974	-18965.7
ST04	-19016	-19008.6	-19000.9	-18996.9
ST05	-19049.8	-19045	-19040.1	-19034.7
ST06	-19040.4	-19035.4	-19029.1	-19021.6
ST07	-18907.2	-18895.1	-18882	-18976.8
ST08	-18823.4	-18807.7	-18788	-18897.9
SX01	-17228.3	-17213.6	-17198.6	-17184
SX02	-17250.3	-17229.2	-17204.3	-17178
SX03	-17309.7	-17301.2	-17437	-17428.7
SX04	-17479	-17471.6	-17463.9	-17459.9
SX05	-17512.8	-17508	-17503.1	-17497.7
SX06	-17503.4	-17498.4	-17492.1	-17484.6
SX07	-17370.2	-17358.1	-17345	-17439.8
SX08	-17286.4	-17270.7	-17251	-17360.9

Wave Height Analysis - Storm Condition

Joint Unity Check

Joint Number	Wave Height (m)			
	11	11.5	12	12.5
2230	0.813	0.85	0.891	0.935
2220	0.719	0.75	0.786	0.825
2210	0.812	0.812	0.812	0.812
1190	0.804	0.804	0.804	0.804
2100	0.644	0.678	0.715	0.754
2300	0.625	0.662	0.702	0.743
7179	0.631	0.668	0.705	0.741
3325	0.692	0.692	0.692	0.72
1199	0.708	0.708	0.708	0.708
2400	0.507	0.548	0.589	0.633

Wave Height Analysis - Storm Condition

Lateral Displacement- 7407

Wave Height (m)	11	11.5	12	12.5
OP01	11.314	11.314	11.314	11.314
OP02	11.200	11.200	11.200	11.200
OP03	10.974	10.974	10.974	10.974
OP04	14.922	14.922	14.922	14.922
OP05	15.339	15.339	15.339	15.339
OP06	14.686	14.686	14.686	14.686
OP07	10.987	10.987	10.987	10.987
OP08	11.414	11.414	11.414	11.414
ST01	36.376	39.636	43.283	48.287
ST02	19.693	21.965	24.732	28.316
ST03	17.014	18.777	20.668	22.639
ST04	24.360	27.439	31.049	41.564
ST05	22.987	24.628	26.520	28.465
ST06	17.631	19.084	20.785	22.645
ST07	13.243	14.242	15.438	16.791
ST08	18.149	19.791	21.553	23.618
SX01	36.247	39.567	43.396	48.407
SX02	19.831	22.124	24.902	28.685
SX03	16.941	18.693	20.565	22.523
SX04	24.005	27.096	31.093	41.653
SX05	22.653	24.269	26.134	28.058
SX06	17.343	18.786	20.479	22.255
SX07	13.125	14.119	15.304	16.645
SX08	18.220	19.869	21.643	23.672

Wave Height Analysis - Storm Condition

Lateral Displacement- 7417

Wave Height (m)	11	11.5	12	12.5
OP01	11.297	11.297	11.297	11.297
OP02	11.055	11.055	11.055	11.055
OP03	10.555	10.555	10.555	10.555
OP04	14.753	14.753	14.753	14.753
OP05	15.353	15.353	15.353	15.353
OP06	14.518	14.518	14.518	14.518
OP07	10.448	10.448	10.448	10.448
OP08	11.115	11.115	11.115	11.115
ST01	36.355	39.615	43.262	48.266
ST02	19.499	21.741	24.477	28.027
ST03	16.242	17.915	19.653	21.513
ST04	23.912	26.937	30.492	40.951
ST05	22.999	24.640	26.532	28.477
ST06	17.458	18.892	20.573	22.413
ST07	12.614	13.559	14.691	15.970
ST08	17.732	19.344	21.074	23.107
SX01	36.230	39.550	43.379	48.390
SX02	19.634	21.896	24.642	28.389
SX03	16.162	17.823	19.543	21.391
SX04	23.551	26.589	30.533	41.039
SX05	22.662	24.278	26.142	28.066
SX06	17.171	18.596	20.269	22.027
SX07	12.501	13.441	14.563	15.830
SX08	17.811	19.430	21.172	23.168

Wave Height Analysis - Storm Condition

Lateral Displacement- 7534

Wave Height (m)	11	11.5	12	12.5
OP01	11.202	11.202	11.202	11.202
OP02	11.326	11.326	11.326	11.326
OP03	10.910	10.910	10.910	10.910
OP04	14.670	14.670	14.670	14.670
OP05	15.309	15.309	15.309	15.309
OP06	14.919	14.919	14.919	14.919
OP07	11.068	11.068	11.068	11.068
OP08	11.159	11.159	11.159	11.159
ST01	36.132	39.375	43.002	47.990
ST02	19.869	22.172	24.969	28.586
ST03	16.927	18.686	20.564	22.528
ST04	23.792	26.818	30.379	40.873
ST05	22.864	24.486	26.362	28.288
ST06	17.861	19.333	21.055	22.935
ST07	13.327	14.328	15.526	16.884
ST08	17.761	19.371	21.099	23.133
SX01	36.006	39.310	43.119	48.113
SX02	20.012	22.336	25.146	28.964
SX03	16.861	18.609	20.468	22.421
SX04	23.440	26.481	30.432	40.972
SX05	22.526	24.124	25.972	27.878
SX06	17.566	19.029	20.742	22.537
SX07	13.201	14.197	15.384	16.730
SX08	17.831	19.447	21.187	23.184

Wave Height Analysis - Storm Condition

Lateral Displacement- 7541

Wave Height (m)	11	11.5	12	12.5
OP01	11.200	11.200	11.200	11.200
OP02	11.181	11.181	11.181	11.181
OP03	10.465	10.465	10.465	10.465
OP04	14.479	14.479	14.479	14.479
OP05	15.315	15.315	15.315	15.315
OP06	14.756	14.756	14.756	14.756
OP07	10.550	10.550	10.550	10.550
OP08	10.876	10.876	10.876	10.876
ST01	36.133	39.376	43.004	47.991
ST02	19.678	21.951	24.718	28.302
ST03	16.126	17.795	19.518	21.371
ST04	23.316	26.287	29.793	40.232
ST05	22.871	24.494	26.371	28.297
ST06	17.693	19.148	20.850	22.710
ST07	12.718	13.665	14.800	16.084
ST08	17.360	18.939	20.635	22.636
SX01	36.008	39.312	43.121	48.117
SX02	19.818	22.112	24.891	28.673
SX03	16.057	17.715	19.421	21.262
SX04	22.963	25.949	29.847	40.336
SX05	22.533	24.131	25.979	27.885
SX06	17.401	18.845	20.540	22.316
SX07	12.594	13.536	14.660	15.932
SX08	17.433	19.018	20.726	22.690

APPENDIX C.5: Spreadsheet on Wave Period Analysis

WAVE PERIOD – OPERATING

Wave Period Analysis - Operating Condition

Load Case Summary

FX

Load Lael	Wave Period (sec)			
	7	7.5	8	8.5
101	3182.475	3183.294	3222.075	3225.482
102	2503.734	2502.63	2515.32	2517.614
103	-15.802	-13.968	-12.297	-11.238
104	-2482.22	-2490.09	-2502.85	-2463.56
105	-3093.88	-3128.85	-3151.56	-3169.09
106	-2474.5	-2477.7	-2500.52	-2464.18
107	-1.362	-2.867	-4.151	-5.41
108	2494.191	2495.123	2509.952	2517.785
111	7291.26	7291.26	7291.26	7291.26
112	1186.612	1186.612	1186.612	1186.612
113	-15.475	-15.475	-15.475	-15.475
114	-1215.97	-1215.97	-1215.97	-1215.97
115	-3961.82	-3961.82	-3961.82	-3961.82
116	-3252.29	-3252.29	-3252.29	-3252.29
117	-16.265	-16.265	-16.265	-16.265
118	3992.798	3992.798	3992.798	3992.798

FZ

Load Lael	Wave Period (sec)			
	7	7.5	8	8.5
101	6.702	-0.304	-5.458	-9.61
102	-14.794	-20.51	-26.187	-29.234
103	-48.581	-44.85	-41.935	-37.899
104	-118.232	-107.95	-137.669	-204.492
105	-128.458	-122.863	-147.623	-135.022
106	-122.73	-150.671	-140.473	-206.513
107	-62.478	-56.492	-52.151	-47.083
108	-17.939	-23.367	-28.69	-30.788
111	99.188	99.188	99.188	99.188
112	-15.928	-15.928	-15.928	-15.928
113	-15.651	-15.651	-15.651	-15.651
114	-61.212	-61.212	-61.212	-61.212
115	-138.85	-138.85	-138.85	-138.85
116	-118.377	-118.377	-118.377	-118.377
117	15.776	15.776	15.776	15.776
118	-7.859	-7.859	-7.859	-7.859

Wave Period Analysis - Operating Condition

FY

Load Lael	Wave Period (sec)			
	7	7.5	8	8.5
101	8.767	7.558	5.971	5.123
102	2263.88	2259.845	2267.724	2266.645
103	3317.69	3308.025	3311.856	3311.665
104	2193.621	2200.266	2210.969	2174.705
105	-11.882	-10.072	-8.094	-6.877
106	-2203.75	-2200.8	-2218.23	-2181.18
107	-3310.91	-3304.05	-3309.97	-3311.05
108	-2240.54	-2240.14	-2251.72	-2257.34
111	8.842	8.842	8.842	8.842
112	1082.332	1082.332	1082.332	1082.332
113	1327.804	1327.804	1327.804	1327.804
114	1067.564	1067.564	1067.564	1067.564
115	-11.328	-11.328	-11.328	-11.328
116	-2908.81	-2908.81	-2908.81	-2908.81
117	-4324.85	-4324.85	-4324.85	-4324.85
118	-3603.12	-3603.12	-3603.12	-3603.12

Wave Period Analysis - Operating Condition

Load Combination

Fx

Load Comb.	Forces (kN)			
	7	7.5	8	8.5
OP01	3640.638	3641.498	3682.218	3685.796
OP02	2857.011	2855.852	2869.177	2871.586
OP03	-17.854	-15.929	-14.175	-13.062
OP04	-2833.09	-2841.36	-2854.76	-2813.5
OP05	-3542.51	-3579.24	-3603.08	-3621.48
OP06	-2824.17	-2827.53	-2851.5	-2813.34
OP07	-1.633	-3.213	-4.561	-5.883
OP08	2846.26	2847.238	2862.808	2871.033
ST01	8207.721	8207.721	8207.721	8207.721
ST02	1432.323	1432.323	1432.323	1432.323
ST03	-18.029	-18.029	-18.029	-18.029
ST04	-1466.53	-1466.53	-1466.53	-1466.53
ST05	-4505.38	-4505.38	-4505.38	-4505.38
ST06	-3643.7	-3643.7	-3643.7	-3643.7
ST07	-17.973	-17.973	-17.973	-17.973
ST08	4461.961	4461.961	4461.961	4461.961
SX01	8207.721	8207.721	8207.721	8207.721
SX02	1432.323	1432.323	1432.323	1432.323
SX03	-18.029	-18.029	-18.029	-18.029
SX04	-1466.53	-1466.53	-1466.53	-1466.53
SX05	-4505.38	-4505.38	-4505.38	-4505.38
SX06	-3643.7	-3643.7	-3643.7	-3643.7
SX07	-17.973	-17.973	-17.973	-17.973
SX08	4461.961	4461.961	4461.961	4461.961

Wave Period Analysis - Operating Condition

Fy

Load Comb.	Forces (kN)			
	7	7.5	8	8.5
OP01	9.911	8.642	6.976	6.084
OP02	2581.604	2577.368	2585.64	2584.508
OP03	3788.165	3778.016	3782.039	3781.837
OP04	2502.407	2509.384	2520.622	2482.545
OP05	-13.4	-11.499	-9.422	-8.145
OP06	-2513.58	-2510.48	-2528.78	-2489.88
OP07	-3780.61	-3773.41	-3779.63	-3780.76
OP08	-2555.26	-2554.84	-2567.01	-2572.9
ST01	9.834	9.834	9.834	9.834
ST02	1299.798	1299.798	1299.798	1299.798
ST03	1624.654	1624.654	1624.654	1624.654
ST04	1282.594	1282.594	1282.594	1282.594
ST05	-12.595	-12.595	-12.595	-12.595
ST06	-3253.12	-3253.12	-3253.12	-3253.12
ST07	-4856.72	-4856.72	-4856.72	-4856.72
ST08	-4020.33	-4020.33	-4020.33	-4020.33
SX01	9.834	9.834	9.834	9.834
SX02	1299.798	1299.798	1299.798	1299.798
SX03	1624.653	1624.653	1624.653	1624.653
SX04	1282.594	1282.594	1282.594	1282.594
SX05	-12.595	-12.595	-12.595	-12.595
SX06	-3253.12	-3253.12	-3253.12	-3253.12
SX07	-4856.72	-4856.72	-4856.72	-4856.72
SX08	-4020.33	-4020.33	-4020.33	-4020.33

Wave Period Analysis - Operating Condition

Fz

Load Comb.	Forces (kN)			
	7	7.5	8	8.5
OP01	-18889.8	-18897.1	-18902.5	-18906.9
OP02	-18914.1	-18920.1	-18926.1	-18929.3
OP03	-18952	-18948.1	-18945	-18940.8
OP04	-19030.8	-19020	-19051.2	-19121.3
OP05	-19042.9	-19037	-19063	-19049.8
OP06	-19035.8	-19065.1	-19054.4	-19123.8
OP07	-18967.6	-18961.4	-18956.8	-18951.5
OP08	-18917.7	-18923.4	-18929	-18931.2
ST01	-18786.7	-18786.7	-18786.7	-18786.7
ST02	-18915.5	-18915.5	-18915.5	-18915.5
ST03	-18915.2	-18915.2	-18915.2	-18915.2
ST04	-18968.3	-18968.3	-18968.3	-18968.3
ST05	-19051.4	-19051.4	-19051.4	-19051.4
ST06	-19027.8	-19027.8	-19027.8	-19027.8
ST07	-18879.5	-18879.5	-18879.5	-18879.5
ST08	-18905.7	-18905.7	-18905.7	-18905.7
SX01	-17249.7	-17249.7	-17249.7	-17249.7
SX02	-17378.5	-17378.5	-17378.5	-17378.5
SX03	-17378.2	-17378.2	-17378.2	-17378.2
SX04	-17431.3	-17431.3	-17431.3	-17431.3
SX05	-17514.4	-17514.4	-17514.4	-17514.4
SX06	-17490.8	-17490.8	-17490.8	-17490.8
SX07	-17342.5	-17342.5	-17342.5	-17342.5
SX08	-17368.7	-17368.7	-17368.7	-17368.7

Wave Period Analysis - Operating Condition

Joint Unity Check

Joint Number	Wave Period (Sec)			
	7	7.5	8	8.5
2210	0.804	0.814	0.825	0.828
1190	0.806	0.802	0.798	0.794
2230	0.754	0.754	0.754	0.754
3325	0.68	0.699	0.723	0.739
1199	0.715	0.703	0.692	0.682
2220	0.669	0.669	0.669	0.669
3326	0.525	0.538	0.564	0.589
2100	0.587	0.587	0.587	0.587
7179	0.585	0.583	0.581	0.579
2300	0.565	0.565	0.565	0.565

Wave Period Analysis - Operating Condition

Topside Lateral Displacement

Lateral Displacement- 7407

Wave Period (sec)	7	7.5	8	8.5
OP01	11.393	11.237	11.231	11.070
OP02	11.274	11.112	10.997	10.834
OP03	11.059	10.901	10.707	10.558
OP04	14.971	14.839	14.759	14.434
OP05	15.271	15.274	15.219	15.103
OP06	14.750	14.642	14.574	14.267
OP07	11.061	10.921	10.794	10.612
OP08	11.482	11.332	11.228	11.106
ST01	31.318	31.318	31.318	31.318
ST02	5.128	5.128	5.128	5.128
ST03	5.278	5.278	5.278	5.278
ST04	8.413	8.413	8.413	8.413
ST05	20.409	20.409	20.409	20.409
ST06	21.108	21.108	21.108	21.108
ST07	15.637	15.637	15.637	15.637
ST08	21.887	21.887	21.887	21.887
SX01	31.324	31.324	31.324	31.324
SX02	5.246	5.246	5.246	5.246
SX03	5.227	5.227	5.227	5.227
SX04	8.250	8.250	8.250	8.250
SX05	20.104	20.104	20.104	20.104
SX06	20.801	20.801	20.801	20.801
SX07	15.501	15.501	15.501	15.501
SX08	21.978	21.978	21.978	21.978

Wave Period Analysis - Operating Condition

Lateral Displacement- 7417

Wave Period (sec)	7	7.5	8	8.5
OP01	11.375	11.219	11.213	11.052
OP02	11.127	10.968	10.853	10.690
OP03	10.630	10.489	10.316	10.179
OP04	14.797	14.675	14.597	14.273
OP05	15.285	15.288	15.233	15.117
OP06	14.578	14.473	14.407	14.099
OP07	10.512	10.388	10.280	10.112
OP08	11.179	11.037	10.943	10.824
ST01	31.297	31.297	31.297	31.297
ST02	5.080	5.080	5.080	5.080
ST03	5.158	5.158	5.158	5.158
ST04	8.355	8.355	8.355	8.355
ST05	20.422	20.422	20.422	20.422
ST06	20.893	20.893	20.893	20.893
ST07	14.879	14.879	14.879	14.879
ST08	21.400	21.400	21.400	21.400
SX01	31.307	31.307	31.307	31.307
SX02	5.196	5.196	5.196	5.196
SX03	5.098	5.098	5.098	5.098
SX04	8.185	8.185	8.185	8.185
SX05	20.114	20.114	20.114	20.114
SX06	20.588	20.588	20.588	20.588
SX07	14.749	14.749	14.749	14.749
SX08	21.498	21.498	21.498	21.498

Wave Period Analysis - Operating Condition

Lateral Displacement- 7534

Wave Period (sec)	7	7.5	8	8.5
OP01	11.277	11.127	11.132	10.977
OP02	11.402	11.237	11.122	10.959
OP03	10.994	10.839	10.645	10.497
OP04	14.713	14.593	14.516	14.191
OP05	15.235	15.248	15.199	15.091
OP06	14.987	14.879	14.807	14.504
OP07	11.143	11.001	10.871	10.691
OP08	11.223	11.080	10.985	10.867
ST01	31.114	31.114	31.114	31.114
ST02	5.159	5.159	5.159	5.159
ST03	5.235	5.235	5.235	5.235
ST04	8.294	8.294	8.294	8.294
ST05	20.319	20.319	20.319	20.319
ST06	21.381	21.381	21.381	21.381
ST07	15.725	15.725	15.725	15.725
ST08	21.427	21.427	21.427	21.427
SX01	31.124	31.124	31.124	31.124
SX02	5.280	5.280	5.280	5.280
SX03	5.186	5.186	5.186	5.186
SX04	8.129	8.129	8.129	8.129
SX05	20.011	20.011	20.011	20.011
SX06	21.067	21.067	21.067	21.067
SX07	15.582	15.582	15.582	15.582
SX08	21.515	21.515	21.515	21.515

Wave Period Analysis - Operating Condition

Lateral Displacement- 7541

Wave Period (sec)	7	7.5	8	8.5
OP01	11.275	11.125	11.129	10.974
OP02	11.255	11.093	10.978	10.815
OP03	10.538	10.400	10.228	10.093
OP04	14.516	14.407	14.332	14.009
OP05	15.241	15.253	15.205	15.097
OP06	14.821	14.714	14.645	14.340
OP07	10.615	10.489	10.378	10.211
OP08	10.936	10.802	10.716	10.603
ST01	31.114	31.114	31.114	31.114
ST02	5.106	5.106	5.106	5.106
ST03	5.091	5.091	5.091	5.091
ST04	8.216	8.216	8.216	8.216
ST05	20.326	20.326	20.326	20.326
ST06	21.173	21.173	21.173	21.173
ST07	14.988	14.988	14.988	14.988
ST08	20.955	20.955	20.955	20.955
SX01	31.125	31.125	31.125	31.125
SX02	5.226	5.226	5.226	5.226
SX03	5.037	5.037	5.037	5.037
SX04	8.048	8.048	8.048	8.048
SX05	20.017	20.017	20.017	20.017
SX06	20.861	20.861	20.861	20.861
SX07	14.847	14.847	14.847	14.847
SX08	21.046	21.046	21.046	21.046

WAVE PERIOD – STORM

Wave Period Analysis - Storm Condition

Load Case Summary

FX

Load Label	Wave Period (sec)			
	9.5	10	10.5	11
101	3186.973	3186.973	3186.973	3186.973
102	2507.11	2507.11	2507.11	2507.11
103	-14.679	-14.679	-14.679	-14.679
104	-2491.7	-2491.7	-2491.7	-2491.7
105	-3127.7	-3127.7	-3127.7	-3127.7
106	-2482.2	-2482.2	-2482.2	-2482.2
107	-2.353	-2.353	-2.353	-2.353
108	2498.591	2498.591	2498.591	2498.591
111	7206.408	7198.7	7241.164	7300.374
112	1195.01	1193.075	1197.246	1201.139
113	-10.635	-9.887	-9.152	-11.451
114	-1170.84	-1167.85	-1180.89	-1189.45
115	-3922.97	-3824.09	-3835.69	-3834.12
116	-3251.16	-3100.17	-3085.97	-3096.5
117	-16.592	-17.365	-22.948	-22.93
118	4002.242	3875.064	3854.648	3865.143

FZ

Load Label	Wave Period (sec)			
	9.5	10	10.5	11
101	1.957	1.957	1.957	1.957
102	-18.594	-18.594	-18.594	-18.594
103	-46.432	-46.432	-46.432	-46.432
104	-112.139	-112.139	-112.139	-112.139
105	-128.572	-128.572	-128.572	-128.572
106	-115.811	-115.811	-115.811	-115.811
107	-58.882	-58.882	-58.882	-58.882
108	-21.625	-21.625	-21.625	-21.625
111	81.948	75.01	70.216	67.458
112	-4.598	-4.885	-4.848	-4.388
113	-9.583	-8.476	-7.138	-46.601
114	-144.068	-132.659	-123.189	-115.729
115	-121.713	-108.629	-166.608	-153.784
116	-115.552	-103.686	-188.358	-173.946
117	14.504	5.933	-85.578	-82.281
118	103.634	81.621	72.185	64.831

Wave Period Analysis - Storm Condition

FY

Load Label	Wave Period (sec)			
	9.5	10	10.5	11
101	8.184	8.184	8.184	8.184
102	2265.215	2265.215	2265.215	2265.215
103	3315.673	3315.673	3315.673	3315.673
104	2202.131	2202.131	2202.131	2202.131
105	-10.766	-10.766	-10.766	-10.766
106	-2208.38	-2208.38	-2208.38	-2208.38
107	-3310.7	-3310.7	-3310.7	-3310.7
108	-2243.91	-2243.91	-2243.91	-2243.91
111	7.402	6.527	5.862	5.37
112	1074.5	1071.167	1073.278	1075.243
113	1283.118	1287.882	1279.46	1229.968
114	1027.354	1024.606	1034.135	1041.274
115	-9.209	-7.675	-6.256	-5.431
116	-2906.86	-2767.82	-2746.6	-2752.96
117	-4313.85	-4089.05	-4069.63	-4058.93
118	-3604.67	-3487.61	-3466.42	-3473.49

Wave Period Analysis - Storm Condition

Load Combination

Fx

Load Comb.	Forces (kN)			
	9.5	10	10.5	11
OP01	3645.4	3645.4	3645.4	3645.4
OP02	2860.6	2860.6	2860.6	2860.6
OP03	-16.7	-16.7	-16.7	-16.7
OP04	-2843.0	-2843.0	-2843.0	-2843.0
OP05	-3578.0	-3578.0	-3578.0	-3578.0
OP06	-2832.3	-2832.3	-2832.3	-2832.3
OP07	-2.7	-2.7	-2.7	-2.7
OP08	2850.9	2850.9	2850.9	2850.9
ST01	8118.6	8110.5	8155.1	8217.3
ST02	1441.1	1439.1	1443.5	1447.6
ST03	-12.9	-12.2	-11.4	-13.8
ST04	-1419.1	-1416.0	-1429.7	-1438.7
ST05	-4464.6	-4360.8	-4372.9	-4371.3
ST06	-3642.5	-3484.0	-3469.1	-3480.1
ST07	-18.3	-19.1	-25.0	-25.0
ST08	4471.9	4338.3	4316.9	4327.9
SX01	8118.6	8110.5	8155.1	8217.3
SX02	1441.1	1439.1	1443.5	1447.6
SX03	-12.9	-12.2	-11.4	-13.8
SX04	-1419.1	-1416.0	-1429.7	-1438.7
SX05	-4464.6	-4360.8	-4372.9	-4371.3
SX06	-3642.5	-3484.0	-3469.1	-3480.1
SX07	-18.3	-19.1	-25.0	-25.0
SX08	4471.9	4338.3	4316.9	4327.9

Wave Period Analysis - Storm Condition

Fy

Load Comb.	Description	Forces (kN)			
		9.5	10	10.5	11
OP01	Operating v	9.3	9.3	9.3	9.3
OP02	Operating v	2583.0	2583.0	2583.0	2583.0
OP03	Operating v	3786.0	3786.0	3786.0	3786.0
OP04	Operating v	2511.3	2511.3	2511.3	2511.3
OP05	Operating v	-12.2	-12.2	-12.2	-12.2
OP06	Operating v	-2518.4	-2518.4	-2518.4	-2518.4
OP07	Operating v	-3780.4	-3780.4	-3780.4	-3780.4
OP08	Operating v	-2558.8	-2558.8	-2558.8	-2558.8
ST01	Storm max	8.3	7.4	6.7	6.2
ST02	Storm max	1291.6	1288.1	1290.3	1292.4
ST03	Storm max	1577.7	1582.7	1573.9	1521.9
ST04	Storm max	1240.4	1237.5	1247.5	1255.0
ST05	Storm max	-10.4	-8.8	-7.3	-6.4
ST06	Storm max	-3251.1	-3105.1	-3082.8	-3089.5
ST07	Storm max	-4845.2	-4609.1	-4588.7	-4577.5
ST08	Storm max	-4022.0	-3899.0	-3876.8	-3884.2
SX01	Storm mini	8.3	7.4	6.7	6.2
SX02	Storm mini	1291.6	1288.1	1290.3	1292.4
SX03	Storm mini	1577.7	1582.7	1573.9	1521.9
SX04	Storm mini	1240.4	1237.5	1247.5	1255.0
SX05	Storm mini	-10.4	-8.8	-7.3	-6.4
SX06	Storm mini	-3251.1	-3105.1	-3082.8	-3089.5
SX07	Storm mini	-4845.2	-4609.1	-4588.7	-4577.5
SX08	Storm mini	-4022.0	-3899.0	-3876.8	-3884.2

Wave Period Analysis - Storm Condition

Fz

Load Comb.	Forces (kN)			
	9.5	10	10.5	11
OP01	-18895	-18895	-18895	-18895
OP02	-18918	-18918	-18918	-18918
OP03	-18950	-18950	-18950	-18950
OP04	-19024	-19024	-19024	-19024
OP05	-19043	-19043	-19043	-19043
OP06	-19029	-19029	-19029	-19029
OP07	-18964	-18964	-18964	-18964
OP08	-18922	-18922	-18922	-18922
ST01	-18805	-18812	-18817	-18820
ST02	-18904	-18904	-18904	-18903
ST03	-18909	-18908	-18906	-18948
ST04	-19055	-19043	-19033	-19026
ST05	-19033	-19020	-19081	-19067
ST06	-19025	-19012	-19101	-19086
ST07	-18881	-18890	-18986	-18983
ST08	-18789	-18812	-18822	-18829
SX01	-17268	-17275	-17280	-17283
SX02	-17367	-17367	-17367	-17366
SX03	-17372	-17371	-17369	-17411
SX04	-17518	-17506	-17496	-17489
SX05	-17496	-17483	-17544	-17530
SX06	-17488	-17475	-17564	-17549
SX07	-17344	-17353	-17449	-17445
SX08	-17252	-17275	-17285	-17292

Wave Period Analysis - Storm Condition

Joint Unity Check

Joint Number	Wave Period (sec)			
	9.5	10	10.5	11
2210	0.812	0.812	0.812	0.812
1190	0.804	0.804	0.804	0.804
2230	0.737	0.73	0.729	0.729
1199	0.708	0.708	0.708	0.708
3325	0.692	0.693	0.693	0.693
2220	0.666	0.67	0.673	0.676
7179	0.584	0.584	0.584	0.584
2100	0.565	0.552	0.543	0.535
3909	0.497	0.511	0.523	0.535
3326	0.534	0.534	0.534	0.534

Wave Period Analysis - Storm Condition

Topside Lateral Displacement

Lateral Displacement- 7407

Wave Period (sec)	9.5	10	10.5	11
OP01	11.314	11.314	11.314	11.314
OP02	11.200	11.200	11.200	11.200
OP03	10.974	10.942	10.942	10.942
OP04	14.922	14.922	14.922	14.922
OP05	15.339	15.339	15.339	15.339
OP06	14.686	14.686	14.686	14.686
OP07	10.987	10.963	10.963	10.963
OP08	11.414	11.414	11.414	11.414
ST01	30.085	29.429	29.138	28.950
ST02	4.665	4.564	4.500	4.435
ST03	4.769	4.716	4.633	4.460
ST04	7.783	7.664	7.618	7.562
ST05	19.824	19.023	18.851	18.497
ST06	21.006	19.571	19.205	18.879
ST07	15.532	14.471	14.233	13.919
ST08	21.778	20.391	19.829	19.449
SX01	30.151	29.497	29.207	29.020
SX02	4.784	4.683	4.618	4.553
SX03	4.715	4.662	4.578	4.403
SX04	7.621	7.502	7.456	7.400
SX05	19.525	18.732	18.561	18.209
SX06	20.699	19.269	18.904	18.580
SX07	15.397	14.345	14.108	13.795
SX08	21.869	20.477	19.908	19.525

Wave Period Analysis - Storm Condition

Lateral Displacement- 7417

Wave Period (sec)	9.5	10	10.5	11
OP01	11.297	11.297	11.297	11.297
OP02	11.055	11.055	11.055	11.055
OP03	10.555	10.525	10.525	10.525
OP04	14.753	14.753	14.753	14.753
OP05	15.353	15.353	15.353	15.353
OP06	14.518	14.518	14.518	14.518
OP07	10.448	10.425	10.425	10.425
OP08	11.115	11.115	11.115	11.115
ST01	30.065	29.409	29.118	28.930
ST02	4.619	4.518	4.453	4.389
ST03	4.688	4.638	4.559	4.409
ST04	7.742	7.628	7.584	7.530
ST05	19.837	19.036	18.864	18.510
ST06	20.792	19.370	19.001	18.677
ST07	14.782	13.780	13.560	13.267
ST08	21.297	19.938	19.391	19.023
SX01	30.135	29.481	29.190	29.003
SX02	4.735	4.634	4.570	4.505
SX03	4.625	4.575	4.496	4.344
SX04	7.573	7.459	7.415	7.361
SX05	19.534	18.741	18.570	18.218
SX06	20.487	19.070	18.702	18.380
SX07	14.653	13.660	13.441	13.149
SX08	21.396	20.031	19.477	19.107

Wave Period Analysis - Storm Condition

Lateral Displacement- 7534

Wave Period (sec)	9.5	10	10.5	11
OP01	11.202	11.202	11.202	11.202
OP02	11.326	11.326	11.326	11.326
OP03	10.910	10.877	10.877	10.877
OP04	14.670	14.670	14.670	14.670
OP05	15.309	15.309	15.309	15.309
OP06	14.919	14.919	14.919	14.919
OP07	11.068	11.045	11.045	11.045
OP08	11.159	11.159	11.159	11.159
ST01	29.901	29.257	28.976	28.797
ST02	4.694	4.592	4.528	4.463
ST03	4.735	4.683	4.600	4.434
ST04	7.687	7.576	7.533	7.481
ST05	19.752	18.966	18.799	18.453
ST06	21.278	19.829	19.470	19.143
ST07	15.620	14.556	14.320	14.005
ST08	21.322	19.965	19.418	19.050
SX01	29.970	29.329	29.049	28.870
SX02	4.815	4.714	4.649	4.585
SX03	4.683	4.630	4.547	4.378
SX04	7.524	7.412	7.369	7.317
SX05	19.450	18.671	18.505	18.162
SX06	20.965	19.521	19.163	18.838
SX07	15.478	14.424	14.187	13.873
SX08	21.411	20.048	19.495	19.124

Wave Period Analysis - Storm Condition

Lateral Displacement- 7541

Wave Period (sec)	9.5	10	10.5	11
OP01	11.200	11.200	11.200	11.200
OP02	11.181	11.181	11.181	11.181
OP03	10.465	10.433	10.433	10.433
OP04	14.479	14.479	14.479	14.479
OP05	15.315	15.315	15.315	15.315
OP06	14.756	14.756	14.756	14.756
OP07	10.550	10.528	10.528	10.528
OP08	10.876	10.877	10.877	10.876
ST01	29.901	29.257	28.976	28.797
ST02	4.643	4.541	4.477	4.412
ST03	4.630	4.581	4.503	4.359
ST04	7.628	7.520	7.480	7.430
ST05	19.759	18.973	18.806	18.460
ST06	21.071	19.635	19.272	18.947
ST07	14.891	13.886	13.667	13.373
ST08	20.855	19.527	18.995	18.639
SX01	29.972	29.330	29.050	28.871
SX02	4.764	4.663	4.598	4.533
SX03	4.573	4.524	4.445	4.299
SX04	7.461	7.354	7.313	7.264
SX05	19.456	18.677	18.511	18.168
SX06	20.760	19.329	18.967	18.644
SX07	14.750	13.756	13.537	13.244
SX08	20.948	19.613	19.075	18.717

APPENDIX C.6: Spreadsheet on Current Velocity Analysis

CURRENT VELOCITY – OPERATING

Load Case Summary

FX

Load Label	Current Velocity (m/s)			
	1.5	1.6	1.7	1.8
101	3148.771	3225.492	3302.913	3367.624
102	2476.085	2538.312	2601.087	2654.708
103	-14.801	-18.654	-18.472	-18.248
104	-2460.59	-2522.92	-2586.88	-2639.03
105	-3088.59	-3166.9	-3245.56	-3311.33
106	-2451.09	-2513.37	-2573.58	-2627.93
107	-2.483	-5.429	-5.194	-4.785
108	2467.728	2529.648	2592.024	2645.092
111	7291.26	7291.26	7291.26	7291.26
112	1186.612	1186.612	1186.612	1186.612
113	-15.475	-15.475	-15.475	-15.475
114	-1215.97	-1215.97	-1215.97	-1215.97
115	-3961.82	-3961.82	-3961.82	-3961.82
116	-3252.29	-3252.29	-3252.29	-3252.29
117	-16.265	-16.265	-16.265	-16.265
118	3992.798	3992.798	3992.798	3992.798

FZ

Load Label	Current Velocity (m/s)			
	1.5	1.6	1.7	1.8
101	1.179	2.74	4.326	6.782
102	-19.391	-17.801	-16.215	-13.691
103	-47.204	-89.35	-88.264	-86.619
104	-112.733	-111.537	-110.321	-108.988
105	-129.261	-127.886	-126.502	-125.21
106	-116.58	-115.077	-153.71	-152.298
107	-59.818	-100.682	-99.331	-97.425
108	-22.585	-20.662	-18.727	-15.852
111	99.188	99.188	99.188	99.188
112	-15.928	-15.928	-15.928	-15.928
113	-15.651	-15.651	-15.651	-15.651
114	-61.212	-61.212	-61.212	-61.212
115	-138.85	-138.85	-138.85	-138.85
116	-118.377	-118.377	-118.377	-118.377
117	15.776	15.776	15.776	15.776
118	-7.859	-7.859	-7.859	-7.859

Current Velocity Analysis - Operating Condition

FY

Load Label	Current Velocity (m/s)			
	1.5	1.6	1.7	1.8
101	8.085	8.284	8.483	8.706
102	2237.338	2293.238	2349.587	2397.703
103	3275.514	3356.061	3438.605	3508.724
104	2174.3	2230.033	2287.153	2333.943
105	-10.669	11.60297	-11.053	-11.298
106	-2180.41	-2236.34	-2288.06	-2337.34
107	-3270.56	-3351.13	-3433.54	-3503.44
108	-2216.27	-2271.73	-2327.58	-2375.05
111	8.842	8.842	8.842	8.842
112	1082.332	1082.332	1082.332	1082.332
113	1327.804	1327.804	1327.804	1327.804
114	1067.564	1067.564	1067.564	1067.564
115	-11.328	-11.328	-11.328	-11.328
116	-2908.81	-2908.81	-2908.81	-2908.81
117	-4324.85	-4324.85	-4324.85	-4324.85
118	-3603.12	-3603.12	-3603.12	-3603.12

Load Combination

Fx

Load Comb.	Forces (kN)			
	1.5	1.6	1.7	1.8
OP01	3605.2	3685.8	3767.1	3835.0
OP02	2828.0	2893.3	2959.2	3015.5
OP03	-16.8	-20.8	-20.7	-20.4
OP04	-2810.4	-2875.8	-2943.0	-2997.7
OP05	-3537.0	-3619.2	-3701.8	-3770.8
OP06	-2799.6	-2865.0	-2928.2	-2985.3
OP07	-2.8	-5.9	-5.7	-5.2
OP08	2818.5	2883.5	2949.0	3004.7
ST01	8207.7	8207.7	8207.7	8207.7
ST02	1432.3	1432.3	1432.3	1432.3
ST03	-18.0	-18.0	-18.0	-18.0
ST04	-1466.5	-1466.5	-1466.5	-1466.5
ST05	-4505.4	-4505.4	-4505.4	-4505.4
ST06	-3643.7	-3643.7	-3643.7	-3643.7
ST07	-18.0	-18.0	-18.0	-18.0
ST08	4462.0	4462.0	4462.0	4462.0
SX01	8207.7	8207.7	8207.7	8207.7
SX02	1432.3	1432.3	1432.3	1432.3
SX03	-18.0	-18.0	-18.0	-18.0
SX04	-1466.5	-1466.5	-1466.5	-1466.5
SX05	-4505.4	-4505.4	-4505.4	-4505.4
SX06	-3643.7	-3643.7	-3643.7	-3643.7
SX07	-18.0	-18.0	-18.0	-18.0
SX08	4462.0	4462.0	4462.0	4462.0

Current Velocity Analysis - Operating Condition

Fy

Load Comb.	Description	Forces (kN)			
		1.5	1.6	1.7	1.8
OP01	Operating v	9.2	9.4	9.6	9.8
OP02	Operating v	2553.7	2612.4	2671.6	2722.1
OP03	Operating v	3743.9	3828.5	3915.1	3988.8
OP04	Operating v	11.6	2540.6	2600.6	2649.7
OP05	Operating v	-12.1	-12.3	-12.5	-12.8
OP06	Operating v	-2489.1	-2547.8	-2602.1	-2653.8
OP07	Operating v	-3738.2	-3822.8	-3909.4	-3982.8
OP08	Operating v	-2529.8	-2588.0	-2646.6	-2696.5
ST01	Storm max	9.8	9.8	9.8	9.8
ST02	Storm max	1299.8	1299.8	1299.8	1299.8
ST03	Storm max	1624.7	1624.7	1624.7	1624.7
ST04	Storm max	1282.6	1282.6	1282.6	1282.6
ST05	Storm max	-12.6	-12.6	-12.6	-12.6
ST06	Storm max	-3253.1	-3253.1	-3253.1	-3253.1
ST07	Storm max	-4856.7	-4856.7	-4856.7	-4856.7
ST08	Storm max	-4020.3	-4020.3	-4020.3	-4020.3
SX01	Storm mini	9.8	9.8	9.8	9.8
SX02	Storm mini	1299.8	1299.8	1299.8	1299.8
SX03	Storm mini	1624.7	1624.7	1624.7	1624.7
SX04	Storm mini	1282.6	1282.6	1282.6	1282.6
SX05	Storm mini	-12.6	-12.6	-12.6	-12.6
SX06	Storm mini	-3253.1	-3253.1	-3253.1	-3253.1
SX07	Storm mini	-4856.7	-4856.7	-4856.7	-4856.7
SX08	Storm mini	-4020.3	-4020.3	-4020.3	-4020.3

Fz

Load Comb.	Forces (kN)			
	1.5	1.6	1.7	1.8
OP01	-18896	-18894	-18892	-18890
OP02	-18919	-18917	-18916	-18913
OP03	-18951	-18995	-18994	-18992
OP04	-19025	-19024	-19022	-19021
OP05	-19044	-19042	-19041	-19040
OP06	-19029	-19028	-19068	-19067
OP07	-18965	-19008	-19006	-19004
OP08	-18923	-18921	-18918	-18915
ST01	-18787	-18787	-18787	-18787
ST02	-18916	-18916	-18916	-18916
ST03	-18915	-18915	-18915	-18915
ST04	-18968	-18968	-18968	-18968
ST05	-19051	-19051	-19051	-19051
ST06	-19028	-19028	-19028	-19028
ST07	-18880	-18880	-18880	-18880
ST08	-18906	-18906	-18906	-18906
SX01	-17250	-17250	-17250	-17250
SX02	-17379	-17379	-17379	-17379
SX03	-17378	-17378	-17378	-17378
SX04	-17431	-17431	-17431	-17431
SX05	-17514	-17514	-17514	-17514
SX06	-17491	-17491	-17491	-17491
SX07	-17343	-17343	-17343	-17343
SX08	-17369	-17369	-17369	-17369

Joint Unity Check

Joint Number	Current Velocity (m/s)			
	1.5	1.6	1.7	1.8
2210	0.802	0.822	0.842	0.859
1190	0.8	0.808	0.817	0.824
2230	0.754	0.754	0.755	0.77
3325	0.685	0.701	0.716	0.727
1199	0.704	0.709	0.718	0.727
2220	0.669	0.669	0.669	0.669
7179	0.583	0.584	0.586	0.588
2100	0.587	0.587	0.587	0.587
2300	0.565	0.565	0.565	0.565
3326	0.531	0.537	0.544	0.548

Topside Lateral Displacement

Lateral Displacement- 7407

Current Velocity (m/s	1.5	1.6	1.7	1.8
OP01	11.142	11.492	11.853	12.170
OP02	11.018	11.383	11.754	12.088
OP03	10.799	11.148	11.423	11.688
OP04	14.723	15.124	15.541	15.899
OP05	15.148	15.532	15.919	16.259
OP06	14.491	14.884	15.324	15.692
OP07	10.860	11.158	11.441	11.704
OP08	11.230	11.600	11.976	12.312
ST01	31.318	31.318	31.318	31.318
ST02	5.128	5.128	5.128	5.128
ST03	5.278	5.278	5.278	5.278
ST04	8.413	8.413	8.413	8.413
ST05	20.409	20.409	20.409	20.409
ST06	21.108	21.108	21.108	21.108
ST07	15.637	15.637	15.637	15.637
ST08	21.887	21.887	21.887	21.887
SX01	31.324	31.324	31.324	31.324
SX02	5.246	5.246	5.246	5.246
SX03	5.227	5.227	5.227	5.227
SX04	8.250	8.250	8.250	8.250
SX05	20.104	20.104	20.104	20.104
SX06	20.801	20.801	20.801	20.801
SX07	15.501	15.501	15.501	15.501
SX08	21.978	21.978	21.978	21.978

Lateral Displacement- 7417

Current Velocity (m/s)	1.5	1.6	1.7	1.8
OP01	11.124	11.474	11.835	12.152
OP02	10.875	11.236	11.603	11.932
OP03	10.388	10.710	10.973	11.225
OP04	14.557	14.951	15.362	15.713
OP05	15.162	15.545	15.933	16.272
OP06	14.325	14.714	15.146	15.510
OP07	10.327	10.605	10.876	11.126
OP08	10.934	11.298	11.666	11.996
ST01	31.297	31.297	31.297	31.297
ST02	5.080	5.080	5.080	5.080
ST03	5.158	5.158	5.158	5.158
ST04	8.355	8.355	8.355	8.355
ST05	20.422	20.422	20.422	20.422
ST06	20.893	20.893	20.893	20.893
ST07	14.879	14.879	14.879	14.879
ST08	21.400	21.400	21.400	21.400
SX01	31.307	31.307	31.307	31.307
SX02	5.196	5.196	5.196	5.196
SX03	5.098	5.098	5.098	5.098
SX04	8.185	8.185	8.185	8.185
SX05	20.114	20.114	20.114	20.114
SX06	20.588	20.588	20.588	20.588
SX07	14.749	14.749	14.749	14.749
SX08	21.498	21.498	21.498	21.498

Lateral Displacement- 7534

Current Velocity (m/s)	1.5	1.6	1.7	1.8
OP01	11.031	11.378	11.736	12.051
OP02	11.142	11.512	11.887	12.224
OP03	10.734	11.081	11.354	11.618
OP04	14.475	14.868	15.278	15.629
OP05	15.119	15.500	15.885	16.222
OP06	14.722	15.119	15.570	15.941
OP07	10.940	11.242	11.526	11.789
OP08	10.978	11.341	11.708	12.037
ST01	31.114	31.114	31.114	31.114
ST02	5.159	5.159	5.159	5.159
ST03	5.235	5.235	5.235	5.235
ST04	8.294	8.294	8.294	8.294
ST05	20.319	20.319	20.319	20.319
ST06	21.381	21.381	21.381	21.381
ST07	15.725	15.725	15.725	15.725
ST08	21.427	21.427	21.427	21.427
SX01	31.124	31.124	31.124	31.124
SX02	5.280	5.280	5.280	5.280
SX03	5.186	5.186	5.186	5.186
SX04	8.129	8.129	8.129	8.129
SX05	20.011	20.011	20.011	20.011
SX06	21.067	21.067	21.067	21.067
SX07	15.582	15.582	15.582	15.582
SX08	21.515	21.515	21.515	21.515

Current Velocity Analysis - Operating Condition

Lateral Displacement- 7541

Current Velocity (m/s)	1.5	1.6	1.7	1.8
OP01	11.028	11.376	11.734	12.048
OP02	10.999	11.365	11.736	12.070
OP03	10.296	10.616	10.878	11.129
OP04	14.287	14.674	15.076	15.421
OP05	15.125	15.506	15.891	16.228
OP06	14.561	14.954	15.397	15.764
OP07	10.427	10.710	10.982	11.232
OP08	10.700	11.055	11.415	11.737
ST01	31.114	31.114	31.114	31.114
ST02	5.106	5.106	5.106	5.106
ST03	5.091	5.091	5.091	5.091
ST04	8.216	8.216	8.216	8.216
ST05	20.326	20.326	20.326	20.326
ST06	21.173	21.173	21.173	21.173
ST07	14.988	14.988	14.988	14.988
ST08	20.955	20.955	20.955	20.955
SX01	31.125	31.125	31.125	31.125
SX02	5.226	5.226	5.226	5.226
SX03	5.037	5.037	5.037	5.037
SX04	8.048	8.048	8.048	8.048
SX05	20.017	20.017	20.017	20.017
SX06	20.861	20.861	20.861	20.861
SX07	14.847	14.847	14.847	14.847
SX08	21.046	21.046	21.046	21.046

CURRENT VELOCITY – STORM

Load Case Summary

FX

Load Label	Current Velocity (m/s)			
	2.1	2.2	2.3	2.4
101	3186.973	3186.973	3186.973	3186.973
102	2507.11	2507.11	2507.11	2507.11
103	-14.679	-14.679	-14.679	-14.679
104	-2491.7	-2491.7	-2491.7	-2491.7
105	-3127.7	-3127.7	-3127.7	-3127.7
106	-2482.2	-2482.2	-2482.2	-2482.2
107	-2.353	-2.353	-2.353	-2.353
108	2498.591	2498.591	2498.591	2498.591
111	7155.259	7259.852	7364.624	7473.863
112	1776.081	1834.019	1892.771	1945.978
113	-15.007	-14.874	-14.666	-14.488
114	-1786.47	-1845.86	-1905.34	-1958.73
115	-4870	-4963.12	-5061.89	-5158.32
116	-4229	-4290.67	-4371.78	-4453.42
117	-26.123	-26.071	-25.756	-25.718
118	4744.014	4813.896	4769.537	4852.358

FZ

Load Label	Current Velocity (m/s)			
	2.1	2.2	2.3	2.4
101	1.957	1.957	1.957	1.957
102	-18.594	-18.594	-18.594	-18.594
103	-46.432	-46.432	-46.432	-46.432
104	-112.139	-112.139	-112.139	-112.139
105	-128.572	-128.572	-128.572	-128.572
106	-115.811	-115.811	-115.811	-115.811
107	-58.882	-58.882	-58.882	-58.882
108	-21.625	-21.625	-21.625	-21.625
111	96.368	98.54	100.693	102.985
112	-31.197	-29.797	-28.412	-26.089
113	-58.6	-57.237	-55.99	-54.697
114	-105.282	-104.541	-103.777	-102.727
115	-203.439	-202.276	-201.22	-200.067
116	-199.196	-197.295	-195.562	-193.784
117	-161.281	-159.884	-157.141	-155.751
118	16.901	18.792	16.477	18.944

Current Velocity Analysis - Storm Condition

FY

Load Label	Current Velocity (m/s)			
	2.1	2.2	2.3	2.4
101	8.184	8.184	8.184	8.184
102	2265.215	2265.215	2265.215	2265.215
103	3315.673	3315.673	3315.673	3315.673
104	2202.131	2202.131	2202.131	2202.131
105	-10.766	-10.766	-10.766	-10.766
106	-2208.38	-2208.38	-2208.38	-2208.38
107	-3310.7	-3310.7	-3310.7	-3310.7
108	-2243.91	-2243.91	-2243.91	-2243.91
111	8.614	8.79	8.963	9.142
112	1612.167	1664.033	1716.635	1764.132
113	2191.156	2260.408	2336.622	2410.743
114	1578.976	1631.984	1685.148	1733.075
115	-12.737	-12.912	-13.106	-13.292
116	-3789	-3845.45	-3918.97	-3992.87
117	-5681.4	-5784.36	-5875.34	-5983.23
118	-4279.16	-4341.87	-4302.4	-4377.06

Current Velocity Analysis - Storm Condition

Load Combination

Fx

Load Comb.	Forces (kN)			
	2.1	2.2	2.3	2.4
OP01	3645.4	3645.4	3645.4	3645.4
OP02	2860.6	2860.6	2860.6	2860.6
OP03	-16.7	-16.7	-16.7	-16.7
OP04	-2843.0	-2843.0	-2843.0	-2843.0
OP05	-3578.0	-3578.0	-3578.0	-3578.0
OP06	-2832.3	-2832.3	-2832.3	-2832.3
OP07	-2.7	-2.7	-2.7	-2.7
OP08	2850.9	2850.9	2850.9	2850.9
ST01	8064.9	8174.7	8284.8	8399.5
ST02	2051.3	2112.1	2173.8	2229.7
ST03	-17.5	-17.4	-17.2	-17.0
ST04	-2065.6	-2127.9	-2190.4	-2246.4
ST05	-5459.0	-5556.8	-5660.5	-5761.7
ST06	-4669.2	-4734.0	-4819.2	-4904.9
ST07	-28.3	-28.3	-27.9	-27.9
ST08	5250.7	5324.1	5277.5	5364.5
SX01	8064.9	8174.7	8284.8	8399.5
SX02	2051.3	2112.1	2173.8	2229.7
SX03	-17.5	-17.4	-17.2	-17.0
SX04	-2065.6	-2127.9	-2190.4	-2246.4
SX05	-5459.0	-5556.8	-5660.5	-5761.7
SX06	-4669.2	-4734.0	-4819.2	-4904.9
SX07	-28.3	-28.3	-27.9	-27.9
SX08	5250.7	5324.1	5277.5	5364.5

Current Velocity Analysis - Storm Condition

Fy

Load Comb.	Forces (kN)			
	2.1	2.2	2.3	2.4
OP01	9.3	9.3	9.3	9.3
OP02	2583.0	2583.0	2583.0	2583.0
OP03	3786.0	3786.0	3786.0	3786.0
OP04	2511.3	2511.3	2511.3	2511.3
OP05	-12.2	-12.2	-12.2	-12.2
OP06	-2518.4	-2518.4	-2518.4	-2518.4
OP07	-3780.4	-3780.4	-3780.4	-3780.4
OP08	-2558.8	-2558.8	-2558.8	-2558.8
ST01	9.6	9.8	10.0	10.1
ST02	1856.1	1910.6	1965.8	2015.7
ST03	2531.2	2603.9	2683.9	2761.7
ST04	1819.6	1875.2	1931.1	1981.4
ST05	-14.1	-14.3	-14.5	-14.7
ST06	-4177.3	-4236.6	-4313.8	-4391.4
ST07	-6281.1	-6389.2	-6484.7	-6598.0
ST08	-4730.2	-4796.0	-4754.6	-4833.0
SX01	9.6	9.8	10.0	10.1
SX02	1856.1	1910.6	1965.8	2015.7
SX03	2531.2	2603.9	2683.9	2761.7
SX04	1819.6	1875.2	1931.1	1981.4
SX05	-14.1	-14.3	-14.5	-14.7
SX06	-4177.3	-4236.6	-4313.8	-4391.4
SX07	-6281.1	-6389.2	-6484.7	-6598.0
SX08	-4730.2	-4796.0	-4754.6	-4833.0

Current Velocity Analysis - Storm Condition

Fz

Load Comb.	Forces (kN)			
	2.1	2.2	2.3	2.4
OP01	-18895	-18895	-18895	-18895
OP02	-18918	-18918	-18918	-18918
OP03	-18950	-18950	-18950	-18950
OP04	-19024	-19024	-19024	-19024
OP05	-19043	-19043	-19043	-19043
OP06	-19029	-19029	-19029	-19029
OP07	-18964	-18964	-18964	-18964
OP08	-18922	-18922	-18922	-18922
ST01	-18790	-18787	-18785	-18783
ST02	-18932	-18930	-18929	-18926
ST03	-18960	-18959	-18958	-18956
ST04	-19015	-19014	-19013	-19012
ST05	-19119	-19118	-19117	-19116
ST06	-19113	-19111	-19109	-19107
ST07	-19065	-19064	-19061	-19060
ST08	-18880	-18878	-18880	-18878
SX01	-17253	-17250	-17248	-17246
SX02	-17395	-17393	-17392	-17389
SX03	-17423	-17422	-17421	-17419
SX04	-17478	-17477	-17476	-17475
SX05	-17582	-17581	-17580	-17579
SX06	-17576	-17574	-17572	-17570
SX07	-17528	-17527	-17524	-17523
SX08	-17343	-17341	-17343	-17341

Joint Unity Check

Joint Number	Current Velocity (m/s)			
	2.1	2.2	2.3	2.4
2230	0.881	0.895	0.886	0.902
1190	0.813	0.828	0.824	0.842
2210	0.812	0.812	0.812	0.812
2220	0.705	0.713	0.706	0.717
1199	0.708	0.708	0.708	0.708
3325	0.692	0.692	0.692	0.692
2100	0.574	0.584	0.595	0.605
2300	0.568	0.578	0.588	0.598
2400	0.557	0.568	0.578	0.59
7179	0.584	0.584	0.584	0.584

Topside Lateral Displacement

Lateral Displacement- 7407

Current Velocity (m/s)	2.1	2.2	2.3	2.4
OP01	11.314	11.314	11.314	11.314
OP02	11.200	11.200	11.200	11.200
OP03	10.974	10.974	10.974	10.974
OP04	14.922	14.922	14.922	14.922
OP05	15.339	15.339	15.339	15.339
OP06	14.686	14.686	14.686	14.686
OP07	10.987	10.987	10.987	10.987
OP08	11.414	11.414	11.414	11.414
ST01	30.376	31.092	31.855	32.685
ST02	8.307	8.632	8.963	9.271
ST03	8.196	8.437	8.703	8.964
ST04	11.857	12.220	12.586	12.925
ST05	25.669	26.230	26.831	27.424
ST06	34.209	36.852	40.055	43.281
ST07	21.618	22.085	22.535	23.035
ST08	30.151	31.820	30.851	33.290
SX01	30.441	31.118	31.822	32.627
SX02	8.443	8.767	9.097	9.404
SX03	8.161	8.402	8.669	8.929
SX04	11.664	12.024	12.389	12.727
SX05	25.292	25.846	26.440	27.027
SX06	33.965	36.610	39.809	43.033
SX07	21.426	21.890	22.337	22.832
SX08	31.165	33.220	32.255	34.689

Current Velocity Analysis - Storm Condition

Lateral Displacement- 7417

Current Velocity (m/s)	2.1	2.2	2.3	2.4
OP01	11.297	11.297	11.297	11.297
OP02	11.055	11.055	11.055	11.055
OP03	10.555	10.555	10.555	10.555
OP04	14.753	14.753	14.753	14.753
OP05	15.353	15.353	15.353	15.353
OP06	14.518	14.518	14.518	14.518
OP07	10.448	10.448	10.448	10.448
OP08	11.115	11.115	11.115	11.115
ST01	30.355	31.071	31.834	32.665
ST02	8.217	8.537	8.864	9.167
ST03	7.925	8.155	8.410	8.658
ST04	11.730	12.087	12.447	12.780
ST05	25.681	26.242	26.843	27.436
ST06	33.913	36.555	39.756	42.981
ST07	20.585	21.032	21.462	21.940
ST08	29.551	31.201	30.240	32.652
SX01	30.425	31.101	31.805	32.610
SX02	8.351	8.671	8.997	9.299
SX03	7.882	8.113	8.367	8.615
SX04	11.529	11.884	12.242	12.574
SX05	25.300	25.854	26.448	27.035
SX06	33.677	36.321	39.519	42.742
SX07	20.400	20.844	21.271	21.745
SX08	30.561	32.593	31.637	34.043

Current Velocity Analysis - Storm Condition

Lateral Displacement- 7534

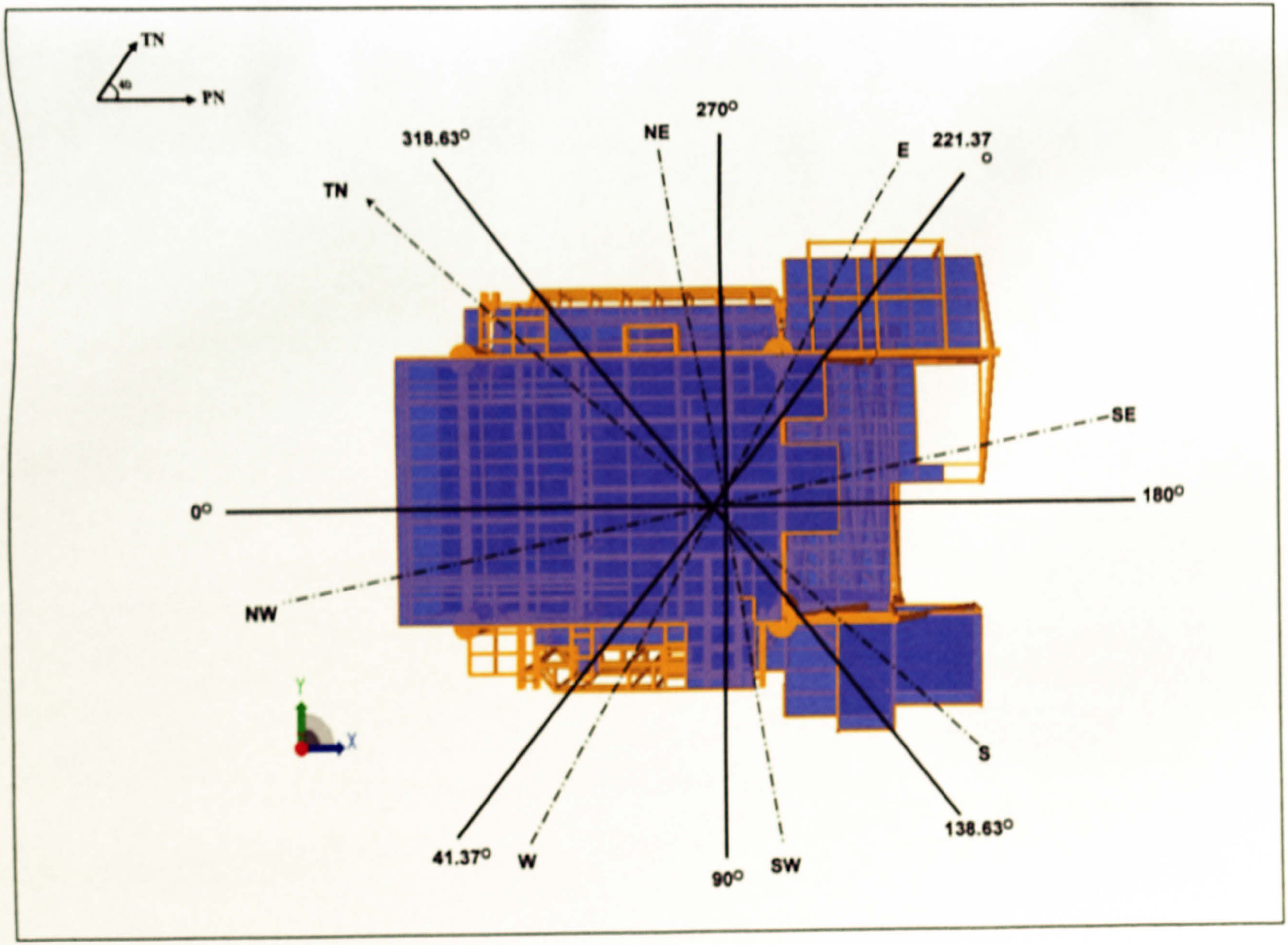
Current Velocity (m/s)	2.1	2.2	2.3	2.4
OP01	11.202	11.202	11.202	11.202
OP02	11.326	11.326	11.326	11.326
OP03	10.910	10.910	10.910	10.910
OP04	14.670	14.670	14.670	14.670
OP05	15.309	15.309	15.309	15.309
OP06	14.919	14.919	14.919	14.919
OP07	11.068	11.068	11.068	11.068
OP08	11.159	11.159	11.159	11.159
ST01	30.179	30.890	31.648	32.473
ST02	8.378	8.707	9.042	9.354
ST03	8.139	8.380	8.646	8.906
ST04	11.652	12.008	12.367	12.699
ST05	25.529	26.085	26.681	27.269
ST06	34.548	37.188	40.386	43.609
ST07	21.721	22.189	22.640	23.141
ST08	29.576	31.228	30.265	32.681
SX01	30.248	30.919	31.618	32.418
SX02	8.518	8.846	9.181	9.491
SX03	8.109	8.349	8.615	8.874
SX04	11.458	11.812	12.169	12.500
SX05	25.148	25.697	26.287	26.869
SX06	34.291	36.932	40.128	43.348
SX07	21.521	21.986	22.434	22.930
SX08	30.580	32.615	31.657	34.066

Current Velocity Analysis - Storm Condition

Lateral Displacement- 7541

Current Velocity (m/s)	2.1	2.2	2.3	2.4
OP01	11.200	11.200	11.200	11.200
OP02	11.181	11.181	11.181	11.181
OP03	10.465	10.465	10.465	10.465
OP04	14.479	14.479	14.479	14.479
OP05	15.315	15.315	15.315	15.315
OP06	14.756	14.756	14.756	14.756
OP07	10.550	10.550	10.550	10.550
OP08	10.876	10.876	10.876	10.876
ST01	30.179	30.890	31.648	32.473
ST02	8.286	8.611	8.942	9.250
ST03	7.842	8.072	8.326	8.574
ST04	11.505	11.854	12.207	12.533
ST05	25.537	26.094	26.690	27.278
ST06	34.261	36.899	40.096	43.318
ST07	20.709	21.157	21.587	22.067
ST08	28.990	30.623	29.669	32.057
SX01	30.249	30.921	31.620	32.420
SX02	8.425	8.749	9.080	9.387
SX03	7.808	8.038	8.292	8.540
SX04	11.307	11.655	12.006	12.330
SX05	25.155	25.704	26.294	26.876
SX06	34.012	36.652	39.846	43.066
SX07	20.512	20.957	21.384	21.860
SX08	29.986	31.997	31.048	33.430

APPENDIX D – WAVE & CURRENT ATTACK ANGLE



Wave and Current Attack Angle